

**The Act and Activities of Invention:
An Autobiographical Phenomenological
Case Study of a Visualizing Inventor**

by

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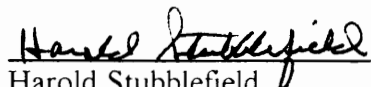
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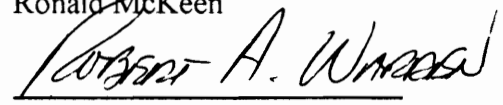
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(ABSTRACT)

The purpose of this research was to further my understanding of the inventive experience by capturing the perceptible thoughts, feelings, emotions, and actions that occur during the development of a Patentable Invention. The author, subject of the study, is an experienced inventor with numerous Patents issued and pending. The invention produced during this research was a mechanical device comprised of approximately seventy parts. Documentation of the product was through a formal Application for a U.S. Patent, filed *pro se*, and accompanied by nine pages of formal drawings also generated by the Researcher/Subject.

The qualitative research process employed a phenomenological framework and included a variety of established data collection techniques, many of which had not previously been applied to the study of invention. Guided by the question of better understanding the experience of invention and its meaning, data were collected in written, verbal, and drawn form. An emphasis on real-time data collection avoided many of the pitfalls of autobiographical and retrospective verbal techniques. Over one hundred pages of transcribed data and over 400 developmental drawings were produced and analyzed.

In addition to the traditional qualitative data analysis processes, the researcher developed a variety of data organization, coding, and analysis techniques providing quantitative insight into graphical data.

The results of the research provided significant insight into invention as an intensive learning experience. The subject, a diagrammatic visualizer, was extensively motivated by acquisition and application of knowledge. Relationships between the inventive experience and emotion, communication, and ambiguity were also identified.

Implications for other inventors, potential inventors, employers, and those interested in the lived experience of inventors are discussed. Although this study was a single representative case, further research may investigate the characteristics and motivations of independent inventors, and specifically a potential relationship between motivated learners and successful inventors.

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They say a journey such as this is never accomplished alone. That is certainly true in my case. I list, fearful of inadvertently leaving someone out.

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Chapter One : Introduction

Mater artium necessitas

Anonymous Latin Saying

Background of the Problem

America's founding fathers recognized the importance of invention to our nation's development more than two hundred years ago. Their understanding was demonstrated by the inclusion of passages in the Constitution designed to "promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries," (Article I, Section 8). From these few words, developed a system of Patents and Copyrights that today leads the world in recognition of, and protection for, intellectual property.

In the United States, a patent is a grant by the government for exclusive use of an idea or process, for a period of seventeen years (with payment of maintenance fees) in exchange for full disclosure of the characteristics and attributes of the item or process. At the end of seventeen years (unless Congressionally extended), the patent enters the public domain and is available to all without incumbrance (Pressman, 1994; Kowalski, 1990; Levy, 1991).

However, a patent is simply the artifact of a formalized inventive act. A more global question might be "What exactly is invention?" Indeed, what is the inventive experience? What are its components? Is it possible to subdivide and broaden our understanding of each? Can this experience survive in a vacuum? What other aspects

of human existence are important to its successful completion? The answer may approach the full range of human skills and activities. However, for purposes of this research, I will constrain the definition of invention to include the body of literature surrounding the specific act, as well as the literature defining problem solving and creativity.

Personal Background

My exposure to, and fascination with, the inventive process began at a young age. My rural Maine education was peppered with examples of Maine inventors and their contributions to society. Too numerous to name, one of the more successful, and certainly one of the most appreciated during the harsh Maine winters, was Chester Greenwood and his 1877 Patent (No. 188,929) for earmuffs (Harris, 1990). Although I never verified the statistic, it was often conveyed that Maine enjoyed the highest per capita rate of patent generation of all the states in the Union.

This enculturation continued during my undergraduate work at the University of Maine. The Industrial Technology program contained several courses focused on current and future industrial design, while continuously sensitizing us to recent inventions, and where appropriate, their Maine originators. The memory of one guest lecturer who held more than seventy patents is still vivid. The academic program, which in retrospect seemed so preoccupied with invention, also contained rigorous requirements for proficiency in mechanical drawing and graphic representation. The course of study created a perception of societal responsibility that could only be fulfilled through the

inventive act. Inventors were people to be admired and emulated and it was our individual and collective responsibility to do so.

This academic environment was further reinforced by my father, a naturally curious man. As I was growing up, he continually quizzed me on how things might have been conceived, produced, how they functioned and most important, how could they be made operationally more efficient?

Professional Background

As an employee of the federal bureaucracy, I have continually attempted to apply my propensity to invent. From a professional perspective, the creative process, and more specifically, the act and activities of invention frequently become commingled with the more traditional aspects of my career. In those instances where innovation was appropriate and tolerated, the result was typically a commendation and token compensation for what in total has been millions of dollars in taxpayer savings/cost avoidance.

Statement of the Problem

Intellectual and Logical Basis

The foundation for my study of invention required one or more bodies of literature, upon which to base my inquiry. One might argue the accomplishment of the inventive act requires a multitude of disciplines. Obviously, the invention literature was considered, and accepting the finite nature of this research, I have limited my inquiry to the appropriate Creativity and Problem Solving literature.

Invention Literature

Although a thorough discussion of the invention literature has been undertaken elsewhere in this study, in summary, the academic research on invention has typically fallen into three broad categories. The first, structured or semi-structured interviews with inventors, followed by an assortment of variations on historical research, and finally, examples of inventors attempting to articulate their processes autobiographically.

Creativity Literature

Understanding of the creative process was a largely unexplored field prior to 1950. A speech by J.P. Guilford, President of the American Psychological Association, chastised the membership for ignoring the potential importance that the study of creativity held for the nation (Guilford, 1987). Dr. Guilford's presentation prompted a groundswell of interest with significant work was undertaken in the 1960s and 70s, laying the foundation for today's understanding of Creativity.

Problem Solving Literature

The Problem Solving (PS) literature, like the Creativity and Invention literature, is far from complete. As we will see, the PS techniques at times appear inextricably intertwined with the creativity literature. The primary difference might be reduced to their respective perceptions of problem constructs. Located somewhere between these areas of investigation is the emerging field of Problem Finding, suggesting the best problem solvers may simply be those most skilled at defining the root problem.

The intersection of PS and Creativity is the subject of ongoing research at the

Creative Education Foundation (CEF), Buffalo, N.Y. Each year, the CEF sponsors a Creative Problem Solving Institute (CPSI) at the University of New York, Buffalo. I was fortunate to have participated in the 1994 CPSI conference, on its 40th anniversary. Although founded on the Osborne/Parnes model (See Osborne, 1953) of creativity, it was a week filled with discussions covering a significant cross-section of current tools, philosophy, and techniques being used by the hundreds of people that had converged from all over the world.

Purpose of the Research

The purpose of this research was twofold, and necessarily sequential. First, I wanted to understand my own process of invention. Specifically, the inventive activities with which I have previously developed and executed patents (No. 5,109,616 & No. 5,188,159) before the U.S. Patent and Trademark Office. My curiosity about the process rests in a desire to improve upon my existing capability, with an eye to executing more complex products in the future. Previous attempts to understand my inventive experience have provided glimpses of insight; however, I have never been able to capture and comprehend the complex set in play during the inventive experience.

The second purpose for this research was my perception of shortcomings or gaps within the Invention, Problem Solving, and Creativity literature. I had spent several years collecting and examining the literature in search of answers. My search included the Scientific, Technical, Psychological, Philosophical, and even anecdotal sources. The results of this search left me frustrated. The available material discussed invention

predominately in the second or third person, best described as “from the outside, looking in.” Few aspects of my perceived inventive process were to be found. Of those that appeared, the total fell far short of what I believed it could or should include. The integrated inventive experience, collected and articulated in the first person singular, was obviously missing.

To restate, the purpose of my research was to better understand my inventive acts. In order to accomplish my goal, certain activities needed to occur. First, a reliable/valid mechanism for data collection was identified. Phenomenology appeared to be the most appropriate. Described by Sanders (1982) as a "research technique that seeks to make explicit the implicit structure and meaning of human existence," Phenomenology in its simplest sense, might be construed as the study of perceived phenomena. Implementation of a Phenomenological framework results in the search for the "essence" of an object or activity. The phenomenological process is accomplished through suspension of judgment, biases, values, and perceptions. It is an approach by which fundamental understandings about a process, in my case invention, was made obvious. Phenomenology was well suited, and had been successfully used for Doctoral self study of conceptual art, by Bukowski (1992).

Next, an inventive act needed to occur. It would be during this inventive act that Phenomenologically data would be collected. Finally, the results of this data collection were to be analyzed, conclusions developed, results integrated into the existing literature, and areas for future research generated.

Research Questions

As previously stated, it was the intent of my research to examine not the artifacts, or products of previous inventions, but the experiences, activities, and process(es) by which invention occurred. To that end I pursued the following Research Questions:

- R1. What is the experience of invention like, and what is the meaning of that experience?
- R2. What thoughts occur during and as a result of the inventive act?
- R3. What feelings manifest as I progress through the Inventive experience?
- R4. What actions occur during the inventive experience?

Significance of the Study

This study has potential significance from a number of separate perspectives. In addition to the personal importance of better understanding my inventive propensities, I believe it to have possible significance for other established inventors, those interested in becoming inventors, those interested in further understanding the lived experience of an inventor, and finally, the employers of inventors.

Importance for Other Inventors

The products and processes of this undertaking hold several possible areas of interest for other inventors. Among these is the application of the phenomenological research process, with its potential for sensitizing the subject toward his or her own thoughts and actions; insight into the process by which a topic for product development was selected; descriptions of prior art considerations; generation and refinement of Patent

Drawings; capturing, organizing, coding, and articulating the results of inventive activities using the processes developed during this research; and finally, preparation of documentation in accordance with the requirements of the U.S. PTO.

Insight for Others Interested in Inventing

Others for whom my research might be of value include those individuals interested in becoming inventors. If one assumes the activities and insights of my research to be exportable to other independent inventors, the possible benefits cover a variety of areas. Included would be the processes and components of the inventive act; interface with the variety of information sources necessary for product development; insight into the available invention, problem solving, and creativity literature; confidence surrounding informal and formal drawing requirements; problems and opportunities when dealing with various aspects of the PTO; the risks and rewards of representing oneself before the PTO; and hopefully, the confidence to attempt an invention of their own.

Significance for the DoD

Each year, significant research dollars are consumed by, or funneled through the DoD. This research encompasses a myriad of mechanical and technical areas and is responsible for a significant percentage of recent technological spinoffs. Even seemingly insignificant insights from my research that increase efficiency within this research funding stream could, by the sheer magnitude of the annual DoD investment, have significant impact on the taxpayer's return on our collective activity.

The Lived World of an Inventor.

Finally, this research might hold significance for those individuals interested in understanding the lived world of an inventor. This includes when and how the inventive experience intersects other aspects of existence, and what aspects of the inventive process generate specific physical, intellectual, and emotional responses.

Assumptions and Limitations

The researcher recognized the extent of this non-traditional undertaking, and acknowledged the risks associated with the process. To mitigate some of those risks, the following constraints were applied.

1. As recommended by Wonder and Blake, (1992), and Bohn and Peat, (1991), my invention was limited to areas of previous inventive expertise. Included was the area bounded by recreational and utilitarian items.
2. The researcher's contractual relationship with his employer required the topic of inventive activity not have immediate value to, nor be the product of any job related activity.
3. The inventive process was considered complete upon filing of the patent application. The time delay between patent application and actual issuance is typically several years. It was deemed impractical for the product of this research to be constrained by the tedious idiosyncracies of the federal bureaucracy. Although termination of the data collection effort prior to patent issuance did not provide positive proof of patent award, the researcher has conformed to all PTO requirements, and paid the initial application fee

(\$365.00) in good faith anticipation of patent award. The researcher also anticipates paying the patent issuance fee of \$625.00 upon patent publication.

Definitions

For purposes of this research, I adopted the following definitions.

Independent Inventor - An individual generating inventions (as defined above) without corporate affiliation or constraint of contractual assignment. In all cases, this definition is applicable during periods when the individual, and his or her products, is external to the privy of, and devoid of responsibility to, any employer. Inventions are typically not the primary source of income and the products of invention are frequently developed externally to previous specialized education or experience.

Invention - The complex human activity resulting in the development or discovery of any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, not previously existing (no prior art), having value, and lacking obviousness to a person having ordinary skill in the art to which said subject matter pertains (35 U.S.C. 101-03)¹. The item or procedure must have been submitted to the U.S. Government under 35 U.S.C. 111 Application for Patent, and accepted as a patentable commodity as outlined in 35 U.S.C. 151 Issue of Patent².

Inventor - An individual who generates inventions (as defined above).

Patent - A patent for an invention is a grant of a property right by the Government to the inventor (or his heirs or assigns), acting through the Patent and Trademark Office. The term of the patent is seventeen years from the date of patent issuance, subject to the

payment of maintenance fees. The right conferred by the patent grant extends throughout the United States and its territories and possessions, constituting “the right to exclude others from making, using or selling” the invention³.

Overview of the Remaining Chapters

Chapter Two contains a brief overview of the US Patent and Trademark Office (PTO), insight into current patent procedures, and a discussion of the relevant invention, problem solving, and creativity literature.

Chapter Three articulates the process by which this research was conducted and includes a discussion of the autobiographical representative case study technique employed.

Chapter Four contains the product and processes of this research. Included are the written, recorded, and drawn products of my inventive experience.

Chapter Five returns to the existing literature in order to integrate the results of this research within the invention, problem solving and creativity material, the applicability of this research to Adult Education. Suggested topics for future research are also provided.

Chapter Two: Review of the Literature

The greatest invention of the nineteenth century was the
invention of the method of invention

Alfred North Whitehead.

Beginning with a brief history of invention in America, this literature review provides a representative sample of the Invention, Creativity, and Problem Solving literature applicable to the inventive experience. Although an extensive discussion of the phenomenological aspects of this research will be provided under Method in Chapter Three, included here are those aspects of the invention literature containing phenomenological overtones.

Invention in the United States

Since before recorded time a segment of the population has exhibited a propensity to develop/create products and/or processes that have never before existed. For some, the task appears simple. Others search a lifetime for a single noteworthy idea. The products of these development efforts vary on a continuum from little noticed, to items that have altered the course of history. For the past 200 years, the cumulative results of "Yankee Ingenuity" have contributed, not only to the evolution of the species, but also to support of an infrastructure created solely to protect those ideas from inappropriate use by others (Post, 1978)(Harris, 1990).

From our founding fathers' Constitutional acknowledgment, sprang the U.S. Patent and Trademark Office, and with it, a process for the extension of exclusive rights to the use of "novel and nonobvious" items for commercial purposes (35 USC 150-160).

Still, the Patent office was not without opponents. One of its major adversaries, Thomas Jefferson, was convinced that no person or organization should hold a monopoly over any other. As fate would have it, the first Patent Act (1789), created a three-person Patent Board composed of the Secretary of State (Thomas Jefferson), the Secretary of War, and the Attorney General. The first U.S. Patent, a process for making potash, was issued in 1790, and signed by then President George Washington.

An avid inventor, Jefferson ultimately concluded that the Patent process was beneficial for the nation. By 1793, Congress abolished the Patent Board and replaced it with a registration system that allowed for the granting of a Patent (Bedini, 1978).

The Patent Act of July 4, 1836 established the requirements for novelty and utility. Under a new numbering system, Patent No. 1, for Traction [Railroad] Wheels was issued the same year (Richardson, 1990). From these humble beginnings, and two hundred years of evolution, came the patent process of today.

Few would argue that American business continues to recognize the need for continued invention. However, during the past two decades, the number of patents to foreign applicants continues to grow (Quigg, 1992). Economic considerations continue to force production offshore. If we are to remain viable as a nation, one of the last vestiges of American expertise, the development of new products and services, must continue to flourish.

A primary source of patents in this country is the corporate Research and Development laboratory, an invention credited to Thomas Edison (Mulconrey, 1993). It

is through these labs that businesses make their corporate commitment to expend today's resources in anticipation of future payback.

Edison's centralization of equipment, and personnel brought a production line mentality to the inventive process. If invention was 99% Preparation, then efficiencies were to be had by formalizing the trial and error inventive process. Seldom had a breadth of technologies been assembled by a single individual prior to this time. Once established, his Menlo Park facility was crucial to Edison's remarkable inventive record. (Mulconrey, 1993). To this day, his total contribution has few rivals (Port, 1993).

In addition to R&D labs, a second major source of American generated Patent applications is from the world of Academia, traditionally the bastion of applied research seldom concerned with marketable commodities. The changing economics of the American landscape has caused universities to take a second look at the potential value of faculty developed patents. Formal alliances between universities and private industry are becoming more frequent than ever before as educational institutions seek to reap the rewards of intellectual and monetary investments (Stopp, & Stopp, 1992).

The Inevitability of Invention

History is filled with instances of simultaneous, or near simultaneous, invention of similar products. Was it simply coincidence, or were other factors at work? Some suggest the fruition of inventive thought cannot precede the requisite technical foundations typically provided by allied fields of inquiry (Wiener, 1954/1993). Books, even BBC/PBS TV shows, have been written and produced examining evolutionary

interrelationships, indeed the "Connections" that must precede a discovery (Burke, 1978). However, investigations into the inevitability of development found its roots many years earlier. Ogburn and Thomas (1922) compiled a listing of 148 essentially simultaneous inventions, in the fields of astronomy, mathematics, chemistry, physics, electricity, physiology, biology psychology, and practical mechanical inventions that occurred between the year 1420 and the end of the nineteenth century.

Independent Inventors

The subject of this self-study research, the subset of inventors known as "independents" have seldom been studied. In one of the few attempts, Udell, Baker, & Colton (1979), suggested the following subcategories as an attempt to differentiate between those inventors that persist without corporate affiliation. Professional Inventors - Although few in number, these are individuals who derive their primary source of income from their inventive activities and as a group, contribute a significant percentage of the independent inventions.

Traditional Inventors - Typically the creative problem solvers who "invent" solutions to everyday problems, they comprise the largest total numbers of independents and most closely fit the idealized, or stereotypical image of the American inventor.

Technological Inventors - These individuals develop inventions based upon formally acquired education and training. Perceived as the technical "elite" they may be full time employees of, and derive their primary income from corporate America. Their independent inventive activities fall outside the scope of their primary employment

contracts.

An analysis of these categories reveals a decided lack of exclusivity within and among the categories. For the Professional inventor, the sole consideration appears to be the source of primary income. The Traditional inventor is defined by the complexity of the product or development process, though the result could be identical to that of the Professional. The last category, the Technological inventor, is a function of education, product complexity (also applicable to the Professional), and possible corporate affiliation, and not excluded from the Traditional. For purposes of this research, I adopted a definition of Independent inventor utilizing the salient but not potentially contradictory threads of the Udell, Baker, and Colton, (1979). To reiterate the definition from Chapter One:

An Independent Inventor is an individual generating inventions (as defined above) without benefit of corporate affiliation, or constraint from previous contractual assignment. In all cases, this definition is applicable during periods when the individual and his or her products are external to the privy of, and devoid of responsibility to, any employer. Inventions are typically not the primary source of income and the products of invention are frequently developed externally to previous specialized education or experience.

The Study of Invention Since 1900

The study of invention or its components appears to have been somewhat cyclical over the last 100 years, with occurrences at approximately thirty year intervals. Beginning just before the turn of the Twentieth century with Hubert (1896) and Royce (1898), a second peak occurred after World War I, with Ogburn and Thomas (1922),

followed by Wiener (1954/1993), Peck (1962), Taylor and Barron (1963), and Stein (1963). By 1989, the academic interest had resurfaced with Weber and Dixon, followed by Perkins (1992), Perkins and Weber (1992), Dixon (1992), and Weber (1992).

Research techniques for invention have typically fallen into three broad categories: structured or semistructured interviews; assorted variations on historical research; and examples of inventors attempting to autobiographically articulate their processes. I will now look at each of these categories in detail.

Interview Techniques

The invention literature contains numerous examples of structured or semi-structured interviews with inventors. Typically, the intent was to extract relevant autobiographical recollections of their inventive processes. Brown (1988), interviewed sixteen “notable” American inventors, ranging from Paul MacCready of “Gossamer Condor” fame, to Jerome Lemelson, an Independent Inventor with more than five hundred patents. Lemelson is fourth in total U.S. Patents behind Thomas Edison, Elihu Thomson, and Edwin Land. An analysis of Brown’s questions indicates several common threads; however, many questions were tailored toward the individual being interviewed. Floyd (1989), provides another example of collecting data on the invention/problem solving activities of others. He encapsulates portions of the quasi-autobiographical information to demonstrate what he perceives as the basis for creative endeavor. In this case, the components include innovation, imagination and inventive activity.

Teeri (1992) collected data on the “Soil Biotron” from Dr. Robert Fogel at the

University of Michigan. The context of the data collection appears to be a cross between interview and interpretation of the thoughts and processes of Dr. Fogel. Examples include such statements as “Dr. Fogel has an unusually diverse combination of interests and expertise that facilitated the development of this project,” and “Dr. Fogel considers the process of scientific inquiry to be an ongoing series of approximations” (p. 152).

Interview-based studies can contain subtle, but none-the-less misleading results. In addition to the autobiographical and verbal report biases, potential methodological flaws include: were the correct questions asked (Merriam, 1988); were the answers accurate, or did “modesty forbid” (Tweney, 1992, p. 32); were the questions correctly phrased (Bogdan, & Biklen, 1982), and interpreted (Bruhn, 1990); were the memories accurate (Conway, 1990; 1990a; Dennett, 1992; Katz, 1987)? These are simple questions, but important considerations when collecting data for sound research.

In contrast to these interview/interpretation techniques, my process eliminated the need to collect data from a separate subject, and limited the interpretation of collected data to establish qualitative procedures.

Historical Research

Also, within the Invention literature, are numerous examples of historical research. Included in this group are attempts to combine invention records retrospectively, reconstructing apparent intellectual and physical processes of the past (Hubert, 1896; Moore, 1969; Jakab, 1989) and the analysis of inventions from within the context of their consequences on society (Peck, 1962; Tweney, 1992). This category also

includes the gain analysis of Weber and Dixon (1989), and the quasi-historical work of Dixon (1992).

In 1896, Hubert, wrote of the “origins, hopes, aims, principles, disappointments, trials, and triumphs” of inventors and even speculated about their “daily lives and personal character” (p. ii). Historical in nature, Hubert’s discussions included Franklin, Fulton, Whitney, Howe, Goodyear, and a dozen others. In closing, he suggests a reordering of history, placing inventors before many of the perceived heros of the time.

Peck (1962), discussed invention not from an individual, but an industrial perspective, specifically the climate for invention in the American aluminum industry after World War II. The discussion provided valuable insight into the motivations for inventing, as well as the national and international impact that inventions within the aluminum industry had upon the world. As might be expected, there was little insight into the individual (or industrial) experience of invention.

Moore (1969) attempted to provide something between a “how-to” and a “who-done-it” book on creativity and invention. Covering a wide variety of subjects from ingenuity, to models and memory, the steps of creativity and even a discussion on whether women are creative. Although there was little insight into the experience of invention, in many ways, this book provides a retrospective on how the nation and its attitudes have changed during the last quarter century.

Jakab (1989), performed a historical investigation into the “creative process that resulted in mechanical flight [and] sought to illustrate a definable inventive method with

which the Wrights produced each of the necessary elements of their airplane” (p. 358). He concluded the Wrights’ success was due largely to “specific research techniques, innate skills, and personality traits . . . [identified to include] their ability to develop abstract conceptual models . . . their capacity to design aircraft using mental graphic imagery and visual thinking, in addition to verbal thought” (p. ii-iii). Although Jakob provided considerable contextual insight into the Wrights’ activity, there was little discussion of their actual inventive experience.

Weber and Dixon (1989), writing in the Journal of Cognitive Psychology, suggest the study of invention to be a “bridge or interface between the worlds of technology and cognitive science” (p. 284). Acknowledging the difficulty with studying invention in the laboratory, they posited that heuristic rules underlie evolutionary changes during the inventive act, and proposed these rules to be consistent with associated psychological processes. Referred to as Gain Analysis, the technique was applied to the evolution of the needle and its application during sewing. Included in this article is a discussion of the difficulties with studying invention in a laboratory setting.

Dixon (1992), considered the Natural Pathways in the Perception of Invention Sequence. Using a quasi-historical approach, she studied the “perceptions of contemporary subjects regarding the development of existing related inventions [to] gain a conceptual organization of inventiveness.” Participants were asked to rank types of tableware (plate, bowl, cup and glass) “in the perceived order of natural development, and rate likelihood that the dish types originated from different sources . . . changes between

dish pairs was motivated by food type, and identify heuristics used to move between dish pairs.” She concluded: a) people think of related inventions as linked in sequential pathways; progressing from simple to complex artifacts; b) organic origins are more plausible than inanimate origins for simple inventions; c) the function an artifact is to serve is seen as a motivating factor behind its invention; and d) the heuristics used between two related inventions are readily recognizable. (p. 2)

Tweney (1992), analyzed the process and practices of Michael Faraday, traditionally credited with the invention of the electric motor. Using entries from Faraday’s diary, Tweney concludes that apart from the practical aspects of the electric motor, the “significance [for Faraday] was theoretical” (p. 34). Tweney’s account is an encapsulation of a thirty-five-year time frame that produced “dozens of papers and thousands of experiments” (p. 36). Although an excellent historical encapsulation, the work provides little insight into the “experience” of invention.

The problems associated with the historical reconstruction are obvious. Results are limited by the quantity, accuracy, and completeness of the available data, and invariably become the products of the researcher's interpretation, understanding, values, and biases (Simonton, 1984). The historical compilation techniques are similarly encumbered, quickly falling prey to lost contexts, incomplete thoughts, and autobiographical biases (Singer, 1990; Sanitioso, Kunda, & Fong, 1990). Other constraints on the process, such as incomplete or inaccurate recording by the inventor, or prior editing of information collected, seldom make these materials suitable for the rigor

of current qualitative research paradigms.

Although never expecting to be perceived as an inventor worthy of historical review, my associated research will, within the less monumental processes applied, avoid the voids and potential inaccuracies represented by some of these authors. Having explored both the Interview and Historical techniques as they have been applied to the study of invention, I shall now turn to the process of autobiographically provided data.

Verbal Accounts

Although I could find no evidence of previous academic self-study of the inventive experience, there are examples of inventors attempting to articulate their processes. Wild (1992), the inventor of “Ultrasonic Echoing” process attempted to convey some of his motivations and personality characteristics that existed throughout his career. By resorting to “a great deal of introspection,” Wild suggested that intuition, curiosity, an ever-inquiring mind were at the core of his success (p. 115). In addition, the ability to define a problem, discern its core, and assess the probability of a solution were also important.

Hillier (1992), the individual largely responsible for the development of the electron microscope, discussed his perceptions on invention and creativity. For invention, the ingredients included: a longstanding high-priority problem; a thorough knowledge of the area under examination; a broad understanding of the field; an understanding of measurement techniques; a thirst for information coupled with intense curiosity; and the element of chance (p. 109). He goes on to suggest an individual’s

maximum creativity may be limited by the inherited characteristic of processing speed(i.e., the speed by which the brain can process information). The final factor, the environment, provides the data and experience necessary to pursue a creative act effectively (p. 112-3).

Morgan (1992), a researcher for the Du Pont Company, suggests researchers should have “training in problem solving, a background of information and experience, curiosity, an open mind, optimism, self-confidence, integrity, persistence, and a sense of urgency” (p. 180).

These data, collected from renowned inventors such as Wild (1992), Hillier (1992), and Morgan (1992) are representative of attempts to autobiographically articulate invention processes. Unfortunately, they quickly become subject to the limitations of verbal reports as data (Ericsson, & Simon, 1980), and more specifically, the autobiographical bias that may inadvertently be introduced (Singer, 1990). Unfortunately the Phenomenological data, indeed the “experience” of the inventive act, is buried in what might be described as a descriptive autobiographical recollection of the past. As we will see in the Verbal Reports section of Chapter 3, this type of material is of limited value when trying to establish the “experience” of invention. My research, existing within the first person singular, minimized the verbal/autobiographical pitfalls through maximization of real time data collection.

Anecdotal Sources

Once sensitized to the “support” available to the independent inventor, the

constant bombardment of goods and services targeted specifically at the needs of the inventor can be staggering. A cursory review of the current media provided the following examples.

Magazines - Periodicals provide both encouragement and a seeming source of support to the independent inventor. By example, Garr (1988), writing in Venture, suggested there was no simple formula for developing, evaluating, and marketing an invention. His suggestions included associating with other inventors to share information on viable inventor support organizations, and utilization of reputable invention evaluation centers, typically available, from a local university.

Mailings - Once entered onto the roles of patent applicants, the unsolicited "support" literature received by an inventor weekly can be staggering. The offers range in scope from "assistance" in matching your Patent with an appropriate manufacturer (for a fee, of course), through a variety of publications designed to provide exposure to the patent's contents, to offers for insurance policies designed to provide legal assistance in the event of infringement claims, and offers for laser engraved copies of the Patent suitable for display in . . . the most formal of settings.

Anecdotal literature on the invention processes is extensive. Typically "How-to" in slant, a representative example would be the work of Griffin (1991), on "How to be a Successful Inventor: Turn Your Ideas into Profit." This book is typical of the "I did it, so can you" syndrome. Published by John Wiley, the ten Chapters include such practical tips as how to develop, patent, and license your ideas. Apparently designed for the

potential or frustrated inventor, there are superficial discussions on a variety of topics, from brain dominance to disclosure statements. A single chapter discusses the "inventor's mind," its nine pages including advice on balancing the brain, and learning to invent using both left and right hemispheres. My research, existing within the first person singular, minimized the verbal/autobiographical pitfalls through maximization of real time data collection.

Perceived Solutions

I will now shift to some salient research attempting to expand our understanding of the inventive process. One of the more notable, Perkins (1992), a senior research associate at Harvard, contributes a topography of invention. This topography rejects invention as a heroic quest of persistence and unexpected encounter, combined with the gift of insight (p. 239), and substitutes a variation of the problem space concepts introduced by Newell, Shaw, and Simon (1958). Referred to as Klondike and Homing spaces, Perkins resorts to an analogy between the frequency of contour lines on a topographic map, and the location of potential solutions. Klondike spaces are depicted by broad flat areas where much searching is necessary to locate any concept of value to the search at hand. Homing spaces by contrast, are areas where numerous contour lines are collocated, thus indicating opportunities where focused concentration might pay higher than average dividends. Conceptually, this work provides a context within which one perspective of invention might be understood; however, the context remains external to the overall experience of invention.

As we will see during my overview of the Creativity literature, attempts to define a generalizable “process” must be part of human nature. Helfman (1992), contributes the only model that purports to be “inventive,” with his presentation of the Analytic Inventive Thinking Model. Initially developed in the then Soviet Union during the 1940's, the concept was to overlay characteristics of known solution processes on unsolved problems. The Model contains nine stages. They include: listing the physical elements; articulating the functional system; understanding the physical shortcomings; selecting the product; requirements of the product; the tool's purpose; the tool's functional visualization and simulation; contradiction identification and formulation; and idea finding. No research could be found on the results obtained from this model.

The Creativity Literature

An understanding of creativity would be incomplete without an appreciation for the influence the American Psychological Association (APA) has had, and specifically the motivation provided by one of its past Presidents, J. P. Guilford. It was at the APA convention of 1950 when then President Guilford addressed his constituents on their apparent unwillingness to understand the importance of research within the creative arena. Citing only 186 titles concerning creativity in the previous one hundred and twenty-one thousand entries (1937-1950) of the Psychological Abstracts, Guilford reiterated the social importance of creativity to both government and industry (Guilford 1987, p.34-35)⁴.

Perhaps inevitably, the identification of creativity as a valuable human

characteristic was driven by the politics of the day. Internationally locked in what would come to be known as the “cold” war, the battle lines were to be drawn on the field of technological advancement. Today, the ability to generate new products and ideas has become a vehicle of international control.

While recognizing the economic importance of creative output, we have yet to articulate a universally accepted definition of creativity (Conrad, 1990). E. Paul Torrance, a leading researcher in the field of creativity measurement concedes: “Creativity defies precise definition. This conclusion does not bother me at all. In fact, I am quite happy with it. Creativity is almost infinite. It involves every sense - sight, smell, hearing, feeling, taste, and even perhaps the extrasensory. Much of it is unseen, nonverbal, and unconscious. Therefore, even if we had a precise conception of creativity, I am certain we would have difficulty putting it into words” (Torrance, 1988, p. 43).

Illusive Definition of Creativity

Logic might dictate that my investigation into the creative act would commence with a definition of creativity. Unfortunately, a definition of Creativity remains an elusive beast. Three years after Guilford's presentation, a study of definitions for creativity produced twenty-five attempts (Morgan, 1953), similar research six years later uncovered more than one hundred definitions of the term (Taylor, 1959, 1975). Current literature continues to debate, not only the fundamental creative act, but the scope and limits of any universally acceptable definition (MacKinnon, 1970a).

Some believe that this seemingly undefinable phenomena must elude our attempts to teach the techniques. Skinner suggests attempts to teach originality an impossible task (1953). Other, more optimistic souls speculate that creativity is actually a combination, or perhaps an integration of various cognitive and personality phenomena, conceivably overlapping such psychological phenomena as intelligence, cognitive style and personality (Sternberg 1988).

Creativity Techniques

As might be expected, human nature has moved quickly to fill the void of understanding about creativity. Numerous people have developed a variety of processes by which any member of the masses can construct a model, "fill the (proverbial) blanks" and acquire a new, better, or more sophisticated product or idea. Unfortunately, most of these "procedures" fail to recognize, or are unwilling to address, some of the most fundamental complexities of creativity. To demonstrate this, I will first examine some "typical" creativity processes, then expand the boundaries of the creativity enigma with an investigation into a portion of the current consciousness literature, suggesting how simultaneous consideration of the two might be necessary to define and fully understand the creative process.

A review of the "creative" processes, espoused by what could best be described as the leading "authorities" in the field, provides interesting similarities. They are all multi-step processes; they all begin with some type of problem identification; and end with the implementation of a "creative" new solution. Along this continuum resides interesting

insight into our understandings and beliefs about the creative process. A representative sample chronologically arranged provides the following:

Osborne (1953), expanded his "brainstorming" technology into a book entitled *Applied Imagination*. Many considered this as a turning point in the study of creativity. Specifics of this process are contained in a similar entry under Problem Solving.

Arnold (1962), provided a four-step process that suggests creativity should be utilized to answer the "unknown." It began with an *Understanding the Problem*, or exactly what is the unknown in question; moves on to *Finding Connections Between the Data and the Unknown*, using a process of devising a plan. In a nutshell, this attempts to solve the problem (the unknown), or if unmanageable, looks for solutions to similar problems. The next step, *Carrying Out the Plan*, includes carefully checking each of the plan's steps to assure correct azimuth and trajectory. Inaccuracies are corrected and reevaluated. The final step, *Examining the Solution Obtained*, not only attempts to validate the selected solution, but evaluates the solution in light of newly acquired understanding of the original "unknown."

With our first five-step process, Zahn (1966), comes a *Period of Insight*, a portion of the creative process considered "indescribable." In total, the process consisted of a *Period of Preparation*, asking questions and attempting to understand the problem; followed by a *Period of Concentrated Effort to Solve the Problem*, where honest attempts are made at finding a viable solution; moving into a *Period of Withdrawal*, ignoring the problem for other conscious thought processes; and succeeded by a *Period of Insight*,

perhaps the subconscious generation of ideas purported to be indescribable. The process is complete with a *Period of Elaboration*, where one articulates the new solution.

de Bono (1970), provided the process of "*Lateral Thinking*" He suggests that creativity is an activity requiring both vertical and lateral thought with the former utilizing information in order to move toward a solution and the latter, using information for a process of "restructuring." Identified as "arational" (p. 197), specific steps associated with lateral thinking include: *generation of alternatives, challenging assumptions, suspending judgment, fractionization* (process decomposition leading to restructuring of parts), *analogies, brainstorming*, and the notion of "*Po*." de Bono suggests that Po is to lateral thinking as no is to vertical, the difference being a shift from the negativism suggested by no. Po is designed to restructure thinking in the lateral plane.

Glover (1980), provided insight into the creative process through a nine step "Rule Discovery Procedure." Beginning with *identification of the problem, describing what the acceptable solutions should look like; listing possible hypotheses* for solving the problem; *categorizing the hypotheses* on basis of similarities; *generating a statement describing rules* utilized to *categorize hypotheses; testing the hypotheses* by categories; *identification of a category* that results in *solution* of the problem; *describing how the rule solved the problem*; and ending with *articulation of rule usefulness* for future problems.

von Oech (1983) created and popularized version of the creativity process containing a total of twelve steps. It begins with *dissatisfaction*, and asks "what are you going to do about it"; suggests *mapping out your plans* and asks if you can "visualize

yourself reaching your objective"; advocates *taking a whack at it*, by identifying "three things you can do to reach your goal"; next you must *eliminate excuses*, by asking "what three factors will make it difficult for you to reach your goal"; requires you to *have something at stake*, to act as a motivator; you must then *acquire support*, or create a "support system" around your idea; next you must *sell, sell, sell*, from the context of "how can you make your idea more attractive to other people"; you must *be courageous*, and structure your environment to facilitate this process; and finally, you must *give yourself a deadline, fight for your idea, and be persistent* (p. 171-181).

Harman and Rheingold (1984) produced a "toolkit" containing a four-step process. First, *guided imagery* as a way of "understanding and employing the unconscious mind"; second, *affirmation* as a way of "reprogramming the unconscious idea-and-image processor"; third, *alert relaxation* designed to "induce what has been called in medical science the relaxation response"; and lastly, *dreamwork*, which takes one "directly into the heart of the idea processor, the deep unconscious" (p. 81).

von Oech (1986), returned with a second installment of the Whack on the Side of the Head, this time entitled A Kick in the Seat of the Pants. With the change in title, comes a shift in the organizational structure of the creative process. For this edition, the original creative activities are divided among four major topic areas, including, *explorer, artist, judge and warrior*.

Miller (1987), provided extensive work on the creative process from the individual, linear, and intuitive perspectives. He also addressed the problems associated

with conceptual blocks. The individual creative process includes seven steps. They include: *be aware of your complete current situation, be persistent in your vision, perceive all of your alternatives, entertain your intuitive guidance, assess your alternatives, be realistic in your actions, and evaluate your results* (p. 52-59). The ten linear techniques include: *matrix analysis, morphological analysis, nature of the business, "reframing" questions, force field analysis, attribute listing, SCAMPER* (substitute, combine, adapt, modify, put to other uses, eliminate, reverse), *alternative scenarios, forced or direct association, and design tree* (p. 66-67). Miller's six "intuitive" techniques include: *imagery, brainstorming, analogy, dreams, drawing, and meditating* (mind-clearing) (p. 84).

Albrecht and Albrecht (1987), suggested creativity techniques can be divided into bands of "Low-weirdness and High-weirdness" procedures. The more conventional processes utilize films, videotapes, discussion groups, etc.; leaving meditation, nonverbal communication, dancing, body sculpture and chanting to those more predisposed to the high-weirdness environment.

Fritz (1991), created an "overview of the creative process . . . not a formula but a form," containing a total of nine steps. The first, *conception*, where one "begin[s] to consider what you want to create"; the second, *vision*, when you have settled "on one and only one [possible] image of the end result is specific and tangible"; third, *current reality*, "to describe what you currently have in relationship to the result you want"; fourth, *take action*, the time to consider the "process" by which develop and implement

your idea; fifth, *adjust - learn - evaluate - adjust*, during this implementation and feedback process learning takes place at both the cognitive and subconscious levels; sixth, *building momentum*, "adds force and momentum"; seventh, *always have a place to go*, which simply suggests maintaining a delta between where you currently are and where you want to be; eighth, *completion*, the project comes to closure and a variety of emotions are experienced; and finally, *living with your creation*, the point at which nothing remains to be done and you transition into the audience for your creation (p. 21-39).

Glassman (1991), identified a problem-solving sequence that produces creative solutions. The steps include: *defining the problem* and listing many problem statements; *identifying criteria* from which to select the final problem statement; *selecting reasonable problem statements*; *listing many ideas*; *identifying criteria* to select ideas; and *combining ideas* into creative trigger-proposals and workable solutions (p. 19).

VanGundy (1992), suggested a six step Creative Problem Solving (CPS) process including: *objective finding*, *fact finding*, *problem finding*, *idea finding*, *solution finding*, and *acceptance finding*.

As evidenced by this collection, there are more similarities than differences with these processes. Most procedures advocate heel-to-toe approaches beginning with a problem and systematically progresses toward a solution purported to be superior to one produced through undisciplined creative undertaking. Some authors recognize subtle differences between personal and group creativity, and distinctions between linear and

intuitive processes (Miller, 1987). Still, fewer recognize the contextual limitations of their inventions.

Over time, the length and complexity of these processes seem to be growing. Unfortunately, little empirical evidence exists to suggest that the more modern processes are more effective than their predecessors. In fact, supportive research is glaring in its absence.

The Problem Solving Literature

Possibly a turning point in the popularization of creativity, Osborne (1953) expanded his "brainstorming" technology into a book entitled Applied Imagination. The creative problem-solving process consisted of three parts. First, Fact-finding, required problem definition and presentation. Essentially a data gathering and analyses process. The second step, Idea-finding, generated a myriad of possible solutions and selected those most likely to be correct. These were again subjected to the idea generation and evaluation process. Idea-finding was complete when the most likely solutions had been modified or combined. The third and final step in creative problem-solving was Solution-finding. It consisted of verifying (testing, etc.) the tentative solutions, followed by selecting, adopting and implementing the winner.

Newell, Shaw, and Simon, (1958), defined problem solving in terms of information processing. Their theory postulates a control system consisting of memories containing symbolized information; primitive information processes, operating on the operating on the information in the memories; and a set of rules for combining these

processes into whole programs of processing (p. 151). To support their problem solving research, Newell, Shaw and Simon developed a computer problem called the Logic Theorist (LT). Although not modeled after human behavior, LT was constructed to prove theorems in logic and as a result, uses many of the processes humans utilize. The axioms of Principia Mathematica were loaded into LT and the computer was challenged to solve successively more difficult problems, each time retaining the successful processes of previous solutions. Ultimately, LT's success depended not on the processing capability of the computer, but the heuristics similar to those employed by humans. Proofs were predicated on four rules of inference; substitution, replacement; detachment; and, syllogism. While acknowledging that "similarity of function does not imply similarity of process" (p. 155), the authors suggest that similarities between man and LT did exist. These included items such as: LT's ability to find theorem proofs; the impact of sequencing problems on LT's proficiency; LT's demonstration of both preparatory and directional sets; LT's ability to exhibit what might be considered trial and error "insight;" employment of simple concepts to classify expressions; and last, LT's ability to develop a hierarchy of problems and subproblems.

Green (1966), provides an overview of the problem solving literature of this century and the generally accepted four step (preparation, incubation, inspiration, and verification) problem solving process. He ultimately advocates information processing models, as an appropriate level of detail between organized behavior and neural activity.

Gagne (1966), suggests that problem solving be "an inferred change in human

capability that results in the acquisition of a generalizable rule which is novel to the individual, which cannot have been established by direct recall, and which can manifest itself in applicability to the solution of a class of problems” (p. 132). From this definition, Gagne posits a four-part model of problem solving. The parts include: sequential action, with completion of one set of events followed by addressing the next set of events; threshold phenomena, alluding to a type of field “strength” necessary before progressing on to a subsequent phase; nongraded responses, action resulting from some preceding event is positive and nongraded; and finally, multiple connections, essentially any event can contribute to any subsequent events (p. 147).

Colgrove (1970), demonstrated that by simply suggesting that a person has a reputation for original thought created a mental set that upgraded their typical problem solving performance. Not only were more original ideas generated, but the final selection of an appropriate solution set was also improved (p. 90).

Burke, Maier and Hoffman, (1963/1970), concluded the use of similar, but simpler problem in preparation for analogous, through more complex obstacles was contraindicated. They suggested the less complex problems frequently provided false directions.

Burke, Maier, and Hoffman (1966/1970) found, under controlled conditions, the presentation of hints prior to the commencement of work resulted in more effective processes. A hint provided after work begins can result in an immediate change in direction, be it positive or negative; may simply be absorbed; or may be used as an

orientation point for future analysis (p. 120).

Maier (1970), discovered that the ability to solve one type of problem well was not indicative of the ability to solve dissimilar problems effectively. In fact, to be an expert problem solver, one would “have to be proficient in a variety of ways, have a knowledge of types of errors involved, have a high frustration threshold, and have constructive motivation” (p. 188).

McCollum (1992), and his study of the Cognitive Dimensions of Human Problem Solving, Invention, and Creativity from Conventional, Connectionist, and Integrated Perspectives, utilized “two expert inventors and two novices [in an attempt to] replicate a mechanical object and a nonsense object.” The process consisted of a laboratory experiment in which the expert inventors were expected to outperform the novices on the design of a mechanical object, while performing equally well on the development of a nonsensical object. Within the constraints of the experiment, no differences were identified between the experts and the novices. McCollum also contributes a discussion of the traditional problem solving literature in light of parallel distributed processing models, suggesting integration of the two might produce new insights into the inventive process. Concluding with an investigation of Edison’s development of the light bulb, McCollum suggests insights might be gained from “unifying conventional and neural processing models.” (p. 2)

von Hippel (1994), begins the process for overlaying traditional problem solving literature on the emerging information age. He begins by suggesting that information of

the 1990's tend to have associated costs, for acquisition, storage, and transfer. Perceiving this as "sticky" information, he explores the ramifications of decentralized information, and its impact on the traditional problem solving processes. von Hippel suggests "sticky" information results in problems being logically transferred from site to site, as requirements for specific information dictate, with time critical problems being subdivided to accommodate concurrent, decentralized solution.

On a related topic, Keeney (1994) discusses decision making from a "value-focused" perspective. Specifically, Keeney suggests alternatives are relevant only for achieving values. The process involves establishing a value set, then operating within this framework during the decision making process.

Problem Finding

Mackworth (1965), was an early advocate for the problem finding aspect of problem solving. In fact, he suggested that finding was more important than solving, since the computer was becoming prominent in scientific investigation, and the reductions in time necessary to solve mathematical problems had been reduced to the point that he feared a surplus of solvers, awaiting the products of relatively few problem finders. Mackworth summarizes the difference between solving and finding as: "problem solving is a choice between existing programs or sets of mental rules - whereas problem finding is the detection of the need for a new program based on a choice between existing and expected future programs" (p. 57).

Getzels (1975), concluded the perception of originality and inventiveness may be more a function of one's ability to define and articulate a problem, than the ability simply to solve problems that are previously defined.

Getzels and Csikszentmihalyi (1975), utilizing art as an area of inquiry, developed a process by which problem finding could be observed and assessed with "satisfactory reliability and validity" (p. 115). This was done with combinations of behavioral measures during the problem finding and problem solution stages, combined with post solution interviews. Behavioral variables during problem finding were significantly related to originality and overall aesthetic value. One additional behavioral variable was related to craftsmanship.

Dillon (1982), revisited the problem finding literature twenty-four years after Newell, Shaw, and Simon (1958) associated it with problem finding. Dillon suggests problem finding to be those "activities, processes and events that precede the solving of a clearly posed problem" (p. 102).

Smilansky, and Halberstadt (1986), working with academically advanced ninth graders, failed to find a significant relationship between those students identified as divergent thinkers and those most capable of problem finding. From this, Smilansky and Halberstadt speculate "the type of creativity represented by divergent tasks is only preliminary to creativity as involved in problem invention" (p. 199), thus requiring "quality" to be considered a property of invention [problem finding], since large numbers of solutions (divergent thinking), may not be related to proficiency in invention.

Lai (1991), provides a perspective on problem solving, or more specifically, problem discovery from the inventor's perspective. Breaking a problem into two questions, one of procedure, the other of evaluation, he begins by suggesting that every problem has a unique set of characteristics, and with a mindset focused upon the global, vice the specific factors, one might identify the operating principles for discovery making. Armed with such knowledge, one must simply reinvent this operating principle to make new discoveries.

In Summary

In summary, the existing invention literature reflects the diverse and complicated activities associated with the act itself. Typically disjointed, often lacking a logical flow, and frequently the result of inadequate and poorly integrated exploration of the existing literature, in all cases, it lacks an understanding of the inventive “experience,” as well as the advantage of combining researcher and subject. The Creativity literature, though significantly more voluminous, is only marginally more insightful. As we have seen, almost fifty years into its “study,” the field is still having difficulty agreeing upon a definition. The Problem Solving literature has received significantly more rigorous attention during the same time period, and although the ongoing dichotomy between Information Processing and Gestalt continues to exist, the ultimate resolution may lie with a further understanding of the biochemistry involved. Also applicable as a foundation for this research is the Problem Finding literature. As we have seen, less progress has been associated with this area of inquiry than its downstream counterpart,

much of our understanding about real and perceived creativity may remain entangled with the problem finding literature. Although individually relevant, and collectively significant in both number and scope, I anticipate the results of my research will contribute directly to one or more of the aforementioned disciplines.

Discussion of Chapter Three

Chapter Three will articulate the process by which this research will be executed. Based upon content and format of the research opportunity, the selection of a qualitative representative case study technique will be articulated.

Chapter Three: Design of the Study

The purpose of this research was to acknowledge and examine the processes by which invention has been studied and reported in the past, and attempt to advance the academic understanding of invention for the future. This was done by capturing the perceptible thoughts, feelings, emotions, and actions that occurred during the development of an invention (as defined in Chapter 1 of this research). The detailed literature review of Chapter 2 provided little insight and few established procedures by which invention has been studied in the past. I could find only indirect references to what might be defined as the “experience” of inventing, typically as a subset of other investigative processes. There were no discussions of the actual experience, or the meaning of the experience, and no discussions of the thoughts, feelings, or actions of an inventor when engaged in the inventive act.

Lai (1991), while writing of the study of invention, suggested, one should “put [them]selves in a concrete but simple situation in which we have to make discoveries and see what we will do. A concrete situation . . . because it is easier to think through . . . a simple situation because [it] is less encumbered by problems of detail” (p. 332).

Accepting Lai’s (1991) suggestion, and in contrast to the established procedures of previous invention research, I developed and executed a process that collected Phenomenological data throughout the inventive act. Unlike the reflective data within the current literature, my data collection was as near “real-time” as possible, and due to its

autobiographical nature, without the loss of content or context that might have occurred during “communication” between subject and researcher. It was through the use of these techniques I was able to capture numerous glimpses of the “essence” of invention. A detailed discussion of the constructs follows.

The Case Study

The case study process collects and analyzes large volumes of data to produce a richness of information necessary for the reduction of complex human experiences into understandable, yet accurate, entities. Known as nonexperimental, even “descriptive,” case studies are conducted when searching for characterizations and explanations having variables that are typically difficult to identify or are too deeply embedded to be easily extracted for study (Merriam, 1988). From its inception, the case study has provided a mechanism by which people and situations may be studied to a depth of understanding seldom provided by other types of research (Bogdan & Biklen, 1982). When applied to the study of invention, it offers a mechanism by which phenomena surrounding the inventor’s activities may be observed (Runyan, 1982, P. 444).

As previously stated, the existing literature contains little of the perceptible thoughts, feelings, emotions, techniques, and activities of an inventor during the process of inventing. The use of the case study technique for this research provided numerous opportunities to capture and analyze the actions, emotions and products of a single inventive act.

Representative Case Study (n = 1)

A subset of the Case Study process, the Representative Case Study (Gordon, & Shontz, 1990), sometimes referred to as the Single Case research (Tracey, 1983; Hilliard, 1993), is designed to provide significant insight into a single subject (Jones, 1993). Tracy (1983) suggests there are three primary types of single case research, Psychohistory, Case Study, and Intensive Design, the first two providing less specification and objectification, the latter supplying more longitudinal qualitative rigor.

With single case research, a complex interrelationship between subject and researcher typically develops. In many of these situations, the maintenance of objectivity is a concern. Kirk & Miller (1986) describe objectivity as a simultaneous maximization of reliability and validity. Defined as withholding judgment on all pieces of collected data until analysis has begun, objectivity is often considered a function of one's integrity as a researcher. The full disclosure of data and analysis techniques frequently substantiates this integrity within the final report (Bogdan & Biklen, 1982; Eisenhardt, 1989).

Meara (1990), raised ethical questions involving case study research. Centered around the complex interrelationship between researcher and subject, this co-researcher interface can deteriorate to a point where the research must be terminated. Understanding some of the complexities and limitations of case studies now allow us to drill one step deeper into the Qualitative research paradigm.

Self-Study

A natural extension of the representative case study is the combining of researcher and subject. Such integration is not without precedent in doctoral research. Bukowski (1992) studied his processes as a conceptual artist, and Johnson (1991) researched her own activities as an assistant school principal. Both adapted existing research procedures for use in the execution of rigorous self study.

When studying invention, Weber and Dixon (1989), drawing on the work of Chase and Simon (1973), suggest we “resort to the study of individual inventors, as experts, and collect extensive protocols” (p. 286). Although previous attempts to understand some of the processes of invention have occurred, there is little evidence of attempts prior to this research, in which the essence, or “experience” of inventing was captured. Reasons for this may be numerous, among them, the limited number of researchers that are also inventors.

The advantages of self-study are many. The researcher and subject are continually collocated. Communication between the two becomes academic. Possibilities of miscommunication on context or meaning are reduced to zero. Unfortunately research is seldom a perfect process. The advantages of self-study have some corresponding limitations. I will now consider some of these limitations.

Autobiographical Research

The combining of researched and researcher provided obvious advantages. Availability and efficiency of communications between researcher and subject becomes

academic, and without the limitations of verbalized perceptions, context is always obvious and accurate. Nevertheless, with these advantages come complications. One such complication unrecognized within the existing literature deals with the fragile context of autobiographical memory. This observed phenomenon suggests people search for and focus on specific memories supporting a desired self-view (Sanitoso, Kunda, & Fong, 1990). Anxiety, mood (Richards, & Whittaker, 1990), and affective responses typically correlated with long-term goals, avoidance, self-gratification, and academic achievement (Singer, 1990) need also be considered when collecting verbal data.

The actual process by which I collected the data had an impact on its viability for insight into the experience of invention. Autobiographical recollections or "retrospective reports" were the least accurate source of data for analysis (Ericsson, & Simon, 1980, p. 226). The implications of this finding suggested my self-study activities required a maximization of data captured in "real-time." However, autobiographical biases were but one facet of data collection within the self study context.

Verbal Reports as Data⁹

Collection of verbal data on the mental processes occurring during the inventive experience was a complex, and sometimes difficult process. Existing research had concluded that although "people may not be able to observe directly their cognitive processes, they will sometimes be able to report accurately about them" (Nisbett, & Wilson, 1977, p. 231). Confidence should be high when the causal candidates are few, perceptually or memorially salient, highly plausible and have been observed to be

associated with the outcome in the past (Nisbett, & Wilson, 1977, p. 255). My previous inventive experiences were critical to complying with perceptually salient and causally associated with invention.

Ericsson and Simon (1980), also reported verbal probing could be a source of insight into cognitive processes, but called into question the mechanisms that are typically used during such data collection. Their theory suggests pieces or "chunks" of information are externally acquired or recalled from short or long term memory, processed, and returned to memory. Incoming data would typically be placed in short term memory awaiting processor time, and once manipulated, returned to short or long term memory. Interruptions or variances in this process wrestled attention from the work at hand to execute the intervening activity. For my study of invention, this implied inventive activities were being brought into some form of memory buffer, processed and returned to the buffer for a resultant change in the design. Data collection interruptions during processing, and manipulation activity would result in unrecognized intermediate steps that would degrade both the mental processes under study and the accuracy of reports on mental activities before and during the interruption. This theory presented grave implications for verbal data collection activities during my inventive experience. It meant that every time I interrupted my inventive processes to capture verbal data, the actual process itself might be degraded. Alternatives had to be found. Fortunately, Ericsson and Simon (1980) also hypothesized some processes become practiced, or automated over time. With this automation comes significantly reduced execution time,

and reduced impact on the process being verbalized. They also divided verbalization into three specific levels of activity. The first, Level One, designates information verbalized from existing language (verbal) code. No processing is necessary other than the verbal articulation of the mental process. The second, Level Two, is information verbalized from a nonverbal source. An example might be the request to verbalize a visualized three-dimensional object. Verbalization will typically reduce the speed at which processing takes place, and frequently degrade the overall verbal reporting. During Level Three verbalization the participant is asked to articulate a single type of information from the entire body of available thought processes. The screening necessary to check and report only the information requested slows the apparent thought process, and as with level two verbalization, may even degrade the verbalization of the specified information. In all instances, the perceptible shifts in Levels Two and Three are reduced when repetitive processes are involved (p. 219, 229).

The implications for my research were several, including the necessity to maximize the use of automated collection mechanisms while adapting other collection techniques to the schema of the data being collected. The trade-off I settled upon was to minimize the impact upon the mental processes under study while simultaneously accepting a reduction in total verbal data collected.

Kellog (1982), building upon Ericsson and Simon (1980), and Nisbett and Wilson's (1977) work, suggested that the nature and complexity of the task at hand may be the primary factor for determining the validity of introspection. Those activities

demanding conscious attention to complete provided accurate introspection, while those not requiring conscious attention were contraindicated as candidates for accurate introspective study (p. 141-143).

Believing my invention activity being a largely visual (imagined) medium, existing largely within the area of Ericsson and Simon's (1980) Level Two (verbal/written reports of non verbalized) material⁶, I designed my data collection processes, mindful of the existing data collection research.

Anticipated Data Collection

Research contributed by Klotz, & Alicke (1989), suggested the recall of mental processes may be directly affected by the appropriateness of the collection schema. The greater the applicability of the process, the greater the accuracy of the data (p. 230-231). To that end, I selected and implemented the following data collection conventions.

A Phenomenological Construct

Phenomenology addresses desires for self-understanding traceable to the ancient Greeks (Larrabee, 1990). Having more modern roots with the German philosophers Brentano and Husserl, major contributors to the Phenomenological movement include Heidegger (Husserl's successor at the University of Freiburg), the Germans Jaspers and Scheler; and the French philosophers Merleau-Ponty, Sarte, and Marcel. American phenomenologists include Edie, Ihde, Lauer, Natanson, and Zaner (Sanders 1982). A review of recent literature suggests continued interest in phenomenological foundations, processes and techniques (Grumet, 1992; Brown, 1992; Bernet, Kern, & Marbach, 1993).

Phenomenology is predicated on the assumption that one may focus understanding at the interface between time and being. This is done at the expense of both the subject and object of experience (Sanders, 1982; Ihde, 1977).

The phenomenological process is accomplished through suspension of judgment, biases, values, and perceptions. It is the process of withholding anything that might act as a filter in order to understand the fundamental nature of the item under study (van Manen, 1990). It is a technique by which fundamental understandings about an experience, in my case invention, may become obvious.

Phenomenology is particularly well suited, and has been successfully utilized for self-study⁷. As previously stated, Bukowski (1992) used Ihde's (1977, 1986) material as the basis for his study of conceptual art. Ihde operationalized the work of Husserl (and others) into what he calls Experimental Phenomenology.

My Phenomenological data collection design began with a phenomenological-based question (van Manen 1990), embodying the perceptible thoughts, feelings, emotions, and actions, indeed the "experience" associated with a single inventive act. The primary advantage of being both researcher and subject was my ability to capture, in great detail, the thoughts and activities experienced throughout the inventive process. By eliminating the need to communicate each aspect of the process to another individual, I captured and identified insights into the inventive experience that had previously gone unnoticed. My process possessed adequate flexibility to capture a majority of the data in a "real-time," mode, with the remaining occurrences designed to minimize reliance on

autobiographical memory.

Anticipated Collection Opportunities

Prior inventive experiences allowed me to identify potential opportunities for data collection. They took the following forms:

Flash thoughts - Lasting less than ten seconds. Their inception was perceived as involuntary, and their duration determined by distractions or conscious abandonment. As an object of data collection, they were one of the most challenging experiences. I found it extremely difficult to capture these apparently random occurrences without impacting the quality or duration of each event.

Short thoughts - Lasting less than two minutes, these processes intentionally induced, and typically searched for, potential solutions to a defined problem. Concentration during these short periods appeared as a fuzzy focus. Termination was a conscious activity.

Periods of moderate effort - Typically lasting between two and ten minutes, it is during those periods I anticipated creating informal sketches and captured written evidence of my thoughts. Using a technique I developed years ago, originally adopted to satisfy the due diligence requirement of the Patent Office, the products of these efforts created an outline for Patent Application and development. Inception and termination had typically been a conscious act.

Periods of concentrated effort - Lasting more than ten minutes, occasionally up to several hours, it was during these periods that I consciously contemplated various aspects

of the problem. Typically existing within some type of formal work process, these periods were reserved for drawing or application development.

Associated thought processes - During previous inventive experiences, I would frequently seek out specific types of physical, intellectual, and emotional stimuli to support the inventive momentum. These would take the form of museums, malls, and both natural and manufactured wonders. Frequently, recreational driving would suffice. I can only speculate upon the reasons for selecting these activities. It may have been the concentration of people, lights, or simply the opportunity to observe and internalize the existence of others.

Reflective thought processes⁸ - Periodically, usually at what might have been considered natural breaks (or milestones) within the inventive process, I tended to reflect upon my activities and decision processes utilized to that point in time, typically comparing ongoing and previous inventive and non-inventive undertakings. The results of this type of thought may or may not have caused a shift in immediate or future activities.

Supporting activities - At seemingly random intervals during the inventive process, I would briefly stop my direct inventive activity in order to develop or acquire some sort of associated developmental capacity. The process typically involves a trip to the lumber yard and results in some new (unique) lighting fixture, shelf, drawing support device, or any piece of equipment that might facilitate some future inventive activity. Seldom was the product imperative for continued work. Over time, these cumulative

enhancements have provided an organic capability which supports ever increasing design complexity.

Anticipated Collection Locations

The context within which this research was conducted was essentially threefold. First, as an inventor in search of the next product; second, as a researcher interested in understanding the processes and activities of invention; and last, the minimal remainder of my existence when I was not acting in either of the previous two capacities.

The activities associated with invention had never been terribly convenient. It had always occurred sporadically throughout most hours of the day and night. Locations included my home, my office, and the most prolific environment, while driving. The combination of background music and constantly changing scenery appeared conducive to inventive thought.

Anticipated Collection Techniques

Prior to beginning this research, I was convinced the inventive process would occur almost randomly throughout the conscious day. As a result, I developed a series of data collection tools designed to facilitate the capture of these occurrences. Included were the written and spoken word, as well as all drawings generated during the invention process. During those times when I was to be unable (or unwilling) to record real-time data, every attempt would be made to describe the incident retrospectively, remaining sensitive to the potential for autobiographical bias. The following comprised my collection mechanisms.

Data Collection Form (DCF) - The Data Collection Form was designed to facilitate data capture during my existence not directly dedicated to the inventive experience. Each DCF covered a thirty minute period of a specified day. The daily forty-eight pages of DCF were the product of a Lotus Spreadsheet that served as the format for both data collection and data entry into an electronic format.

Numeric Shorthand - This shorthand was developed in an attempt to introduce written efficiencies by reducing the large volumes of data expected. The shorthand was divided into six broad categories: Product; Process; Initiation; Concentration; Emotion; and Perceptible Progress.

Real-time Voice Recording - Anticipated uses included data collection while driving, and anywhere alternative mechanisms might be inappropriate. Each recorded event was encoded with a DTG. Due to the difficulty transcribing large volumes of voice recordings, every attempt was to be made to limit the use of this medium.

Developmental Sketches (DS) - In addition to the DCF, I anticipated carrying an operationalized sketch pad suitable for capturing the various pen scratches that typically terminated with a new design. The DS format was one I had used for several years and included an area for informal sketches combined with the framework of the written Patent Application. This format had previously been useful for disciplining the thinking processes associated with patentable items.

The Infamous "Clipboard" - I had modified a standard clipboard holder to include a pair of digital clocks, accurate to the second, a calculator, several Velcro patches for

securing a few rudimentary drawing aids, and my tape recorder when not in its belt sheath. This device and a supply of DS Forms were to accompany me throughout the inventive experience.

Formal Drawing Development - Formal drawings, like the developmental sketch process, were anticipated to be exclusively visual. The information embedded within the drawings was difficult to extract and became the subject of an analysis process developed and explained in Chapter 4.

Data Organization

All data collected during this research was assigned a Date Time Group (DTG). This process was a logical extension of data generation activities and facilitated the electronic cataloging, storage, and manipulation during data. No duplicate DTG were generated, and all were entered onto electronic spreadsheets. As will be discussed in Chapter 4, this process contributed to the development of data ordering, coding, and analysis activities previously unavailable in the invention literature.

Data Analysis

The results of my Phenomenological data collection activity were designed to be analyzed in the following ways.

Event Time Line - Unlike previous self-study research (Bukowski, 1992; Johnson, 1991), my data collection design provided for date, time, content and context annotations. The addition of those components was intended to provide insight into the propensity, frequency, depth, and motivation associated with comprehensible (and recordable)

inventive thought. Even simple graphical displays of these data were expected to reveal significant trends with respect to ongoing contextual activities and their impact (positive or negative) upon the inventive process.

Data Collection Growth Curve - An analysis of DCFs was anticipated to provide insight into a potential data collection growth curve. Simply stated, it was designed to indicate the rate and direction of the captured thought processes over time.

In Summary, using the Case Study framework of Eisenhardt (1989), the research question format of Yin (1984), the Representative Case practices outlined by Gordon, & Shontz (1990), the autobiographical limitations suggested by Conway (1990, 1990a), and factoring the experience and constraints of Burkowski (1992), it was the intent of this research to describe the phenomena so well that "others have little difficulty seeing the same phenomena in their own experience and research" (Dyer & Wilkins, 1991, p. 617).

Overview of Chapter Four

Chapter Four provides the product and processes of this research. Included are the written, recorded, and drawn products of my inventive act.

Chapter Four: Results of the Study

Although it may be perceived as unusual to begin Chapter 4 by outlining the product of the research, for this investigation, I believe it necessary to distinguish between the "product" of the study, and the "results" of the study.

The product of this study was a recreational device, specifically a reusable, mechanical Grenade, designed to be employed by individuals engaged in the sport of Paint Ball. Specifics on the mechanism are outlined in a copy of the Patent Application, entitled Reusable Paint Ball Grenade, Reloadable with Standard .68 caliber Paint Balls and Formal Drawings, included as Appendix A.

A review of this material will provide not only insight into the product of this research, but more importantly provide a context within which the ensuing discussion of the "results" of the research may exist.

The results of the study are provided in this chapter. They include the phenomenologically collected data, to which traditional qualitative analysis techniques were applied, combined with graphical data organization and analysis for drawn materials that are original to this research.

Review of the Anticipated Process

The intent of this research, as outlined in Chapter 3, was to capture the perceptible thoughts, feelings, emotions, and actions that occur during the development of an invention, indeed the "experience" of invention. Prior to the beginning of data collection,

I had designed a data collection process that maximized opportunities to collect real-time data, as the "experience" was being "experienced." These artifacts were based upon constructs that had existed in previous inventive activities, and included a variety of mechanisms to facilitate real time data collection. Included were intellectual, electronic, and physical components.

The data collection package contained a Data Collection Form (DCF) (Appendix B), consisting of forty-eight pages per day, which provided timed collection capability for each of the 1440 minutes in the day. I had also constructed a data collection folder containing a clipboard, calculator, and two clocks, one displaying hours and minutes, the second, constantly displaying the passing seconds.

The DCF was supplemented with a process unique shorthand, or coding system that facilitated the capture of data, including location, emotion, type and duration of the experience involved. This coded data was to be entered into an electronic spreadsheet for tracking and analysis purposes. Anticipated analysis techniques included the traditional qualitative coding of the phenomenological data, plus some time/activity results.

The design intent was to construct a process that would minimize the impact of data collection on the actual inventive "experience." Fortunately, the original proposal included adequate latitude to remain appropriate during what became an atypical inventive experience when compared with previous inventive acts.

The Experience of Invention

The Actual Process

The generation of an invention can be a complex task, consisting of many individual activities that contribute to separable developmental stages. I had previously observed these operations to be independent of one another; however, as this project matured, and the design complexity increased, the differentiation between activities and stages becomes increasingly difficult to establish. I will begin with some of the more fundamental aspects of the undertaking, some process, some content. As I progress through the results toward the final product, I would urge the reader to remain sensitive to this information/activity convergence and observe the summarization contained within Patent Application and Formal Drawings.

Origin of the Concept

Many will ask where the idea, or concept of a Paint Ball grenade originated. It is a legitimate question, and I suggest it to be a question outside the scope of this undertaking. I believe the material to be presented in the coming pages will support this assertion. The concept for a Paint Ball grenade, or any other product of essentially associative thinking is external to the development of, indeed the "invention" of the product.

For the Paint Ball grenade, the associative flash (perceived duration a few milliseconds) was the product of a discussion with a colleague who had long been a participant in the sport of Paint Ball. I sat in amazement as he described a sport

consisting of individuals attempting to shoot (and therefore disqualify) each other with paint-filled gelatin capsules fired from CO₂ powered guns and propelled at 300 mph. Once over the shock of grown, well-educated individuals participating in such activities, I drew upon my years of Ammunition School education/training to query him about a variety of Paint Ball specific counterparts to common ammunition/military devices. It became obvious that this relatively young, but well funded sport (the average player spends \$40. per day to play) might be ripe for development of secondary market products. This was borne out by a careful search through dozens of Paint Ball magazines published in this and other countries over the last three years. Was the paint ball grenade the only idea I could have pursued? The answer is a resounding NO! It was but one of a couple hundred possible ideas, five or six of which were paint ball related.

When and Where It Began

My inventive activity formally began in my home, at 1530 hrs. on 27 May 1995, and concluded at the Ft Belvoir, VA. Post Office on 01 Aug. 1995 at 1445 hrs. It was at that moment I relinquished possession of the patent application to the Postal employee behind the counter. Thirty days later, the package was assigned serial number 08/510101 with a 01 Aug. filing date. A week later the PTO granted authority for me to begin filing patent applications outside the United States.

The "experience" of inventing is so closely interwoven with the remainder of my existence that arbitrarily to say it began at 1530 hrs on 27 May is in all likelihood inaccurate. Was I to draw a line prior to this date, it might be scribed at prospectus

completion, thirty days prior, or perhaps a day, or a week earlier. I would describe the experience as beginning with the emotional buildup, perhaps simply the anticipation of identifying and solving another challenge. As will be articulated here, the process of invention typically includes almost every emotion and most of the activities common to my existence.

Primary Work Times

For descriptive purposes, I will subdivide productive time between computer and non-computer assisted activities. This distinction provides differentiation in location, volume, and frequency.

Initially, productivity was defined as constructive thought that could be perceived as progressing toward some final goal. It existed with or without the computer, and was considered enjoyable. Like a new job assignment, or moving to a new city, beginning the patent journey can be an exhilarating undertaking.

Within a few days of commencing the "experience," the computer had become the central focus of effort. When away from the computer, I found myself limiting my activity to those concepts/processes where the computer provided the least payback. I did not realize this trend until after data organization had begun. This discovery was a marked shift from my previous inventive experiences, during which "anytime" was a good time to work on the project.

Work Environment

My favorite workplace (and computer interface) was at home, on the bed (public

apologies to my wife) using an excessively complex and over engineered lap desk, with bells, whistles, lights, controls, and a portable printer. The Rube Goldberg contraption could easily be mistaken for the control room at CNN. There was always at least one TV on, frequently without volume, and a classical CD to be playing in the background. The room is ringed with track lighting, and the thousand watts of direct and indirect halogen output is reminiscent of Death Valley at high noon.

Initially I did a majority of the work at home. After recognizing my tendency to avoid work when a computer was unavailable, I managed to migrate my activity from the full size PC beside the bed, to a portable that typically sat on my lap. With this shift, came a perception of mobility. Although I infrequently took the laptop outside the house, the perception of mobility somehow made me feel comfortable. Initially my link to the computer constrained my activity to those times that the computer was available. The newfound mobility with the laptop appeared to facilitate inventive thoughts to occur when the computer was simply available, even if it were not up and running. In recognition of this apparent phenomenon, I carried the laptop any number of places, even when I knew there would be almost no chance of setting it up. If the availability of the computer was the catalyst for productivity, then "a traveling it would go!"

The next location of importance to the project became my office; however, as the project matured and I began producing more than a Megabyte of data per day, its full potential was realized only after purchase of a portable 100M floppy drive which facilitated transfer of large programs and documents. Except for the bed, my office was

very similar to home (but it gets vacuumed more often). TV and stereo were always going, with large quantities of incandescent light.

The final productive environment was my Van. Equipped with additional storage batteries and the capability to produce 110v AC power, the van hosted my activities on several occasions, as Mona and Ethan shopped, or played, and let Daddy work on his "silly old dissertation".

Productive Time Frames

As will be evidenced by the documentation, what might be considered productive time frames was redefined almost daily. I did not typically work past midnight, nor before five in the morning. A majority of the work was completed with the aid of one or more computers. Of the non-computer periods, the most productive were while driving or sitting in traffic.

Within my data, there are several references to driving to the mall, sometimes for shopping, more frequently to work and wait for my family. While these expeditions were perceived to contribute to my motivation and energy level, there were few occasions when I could accomplish meaningful work in the presence of others. Perhaps it was distraction, perhaps there is an aspect of the process that I perceive to be private. There are times when I am unwilling to subject the process to the scrutiny of the general public.

Expansion of the Computer's Role in the Invention Process

During development of earlier patent applications, use of the computer had been

limited to word processing activities during development of the Specification (application). However, with an eye to the future, and the advent of flexible, economically viable, and commercially supported technical drawing programs, I decided to adopt the computer for both the creation and generation of formal drawings. Formal Patent drawings must meet strict quality standards¹⁰ and my desire was to use the computer in lieu of the nearly 100 hours devoted to drawing preparation during previous inventive undertakings. I realized some of the time savings would be offset by the software learning curve; however, even modest reductions in the time spent hand-drawing and manually inking was worth the risk.

Data Collection

The results of this study were accumulated and retained in multiple notebooks during the research period. Each was duplicated and existed at a minimum of two locations. Although falling outside the data collection portion of the research, the electronic manipulation, and back-up of the four-hundred plus drawings, required several hundred hours of work not reflected as part of the process. In those few instances where this activity directly contributed (i.e., I noticed something that impacted the project), the time was appropriately logged. Otherwise, it comprised sunk cost.

The advantage of autobiographical Phenomenological research is an immediate awareness of data collection activities that impact (cause shifts in) the experience under study. Such was the case for several of the artifacts I had developed for data collection. Although initially perceived as useful, as the complexity of the product and my attendant

concentration increased, many of the anticipated devices were discarded for what I believe became more contextually appropriate mechanisms. As stated earlier, it became necessary to invent a process for the self-study of invention.

Occurrence vs. Capture

It appears there were essentially two types of thoughts, those thoughts perceived as occurring voluntarily and those not perceived as intentional. Each may vary in frequency, duration, and content/context. Thoughts defined as involuntary frequently evolve into the voluntary, and those of a voluntary nature can take on an involuntary flavor. The latter occurred twice during my experience, both times leading to a significant shift in my perspective on the problem. Both times, what I believed to be a voluntary thought shifted into an involuntary phase and the resultant transformation improved the ultimate design.

Philosophically, one might ask if any thought, be it perceived as intentional or unintentional, remains intentional throughout its existence. The associative process discussed under concept formulation can be a very systematic undertaking during which appropriate objects from definable categories can be applied to a particular understanding of a situation. One might question at what point the classifiable group of items becomes depleted, and items from another class, or even apparently random items, come into play, what about those instances where several categories are applied interchangeably? Is the shift intentional? Sometimes yes, other times no! Is the result of a Yes, different from that of a No? Can this ever be known? For those of us possessing thought processes

perceived as shifting several times a second, finishing a sentence, and remembering what and why you started to write is frequently difficult.

My point to this, if there is one, is that the Phenomenological capture of this type of data is at best problematic, and at some point becomes physically impossible. As long as the tongue and written word remain time consuming and cumbersome, an accurate articulation of that type of thought process must remain an undisclosed experience. I do not mean to imply that numerous thought processes cannot be experienced and articulated, and I have done so to the best of my ability. Unfortunately, until the medical and physical sciences progress to the point where we can externally capture, and record (assuming there is but one channel of thought) such information, I suspect it must remain the purview of those simultaneously blessed and cursed with the existence.

Specifics on the Collection Process

During this research, the various aspects of the experience were captured at most hours of the day and night. Anecdotally, my perception is that there were times when the quantity and quality were superior; however, the analysis process lacks sophistication to make any definitive statements on this account.

My abandonment of the shorthand process was swift. After months of preparation and significant practice, I found the DCFs to be physically cumbersome to print, collate, and carry, but more important, I found the format more limiting than I suspected during the design process. To be fair, the convenience of the audio tape contributed to my dislike of the DCF/shorthand worksheet.

The first information required by the DCF was a date time group. This requirement was a distraction that many times derailed the entire collection effort. With the tape, inflection, context, and background noise were all automatic, and the date time group could be entered anywhere appropriate. The downside to the tape, was transcription; it was a long and tiresome task.

As time went on, my use of the tape also diminished, though not as abruptly as the shorthand. As will be seen and described, my use of the tape began as a full partner in the design process. It remained with me at the computer, and as thought processes could be isolated and recorded, I did so. Over time, however, the tape also became an intrusion into the process. As the design and physical drawing process became more complex, my concentration upon and connectivity with the computer overshadowed attempts to collect other types of data.

Types of Data Collected

The data collected from this experience fell into three broad categories. The first, consist of transcripts from many hours of verbal record keeping. Next, were a relative few written notes, most as scribbles on various iterations of developmental drawings. Last, and most important, were the developmental drawings, a total of 413, each containing a wealth of embedded information. When taken within the context of the whole, they provided more insight into the thought processes of this experience than would have been contained in a continuous verbal transcript of the entire sixty-five days.

Developmental Drawings

Traditional phenomenologists may shudder, and perhaps it is a result of my combined researcher/subject roles, but in my opinion, a large percentage of true experience of this inventive act is represented by the 413 developmental drawings. I will attempt to demonstrate the richness of their content in the data analysis section.

Verbal Data

Verbal data, collected throughout the experience, was transcribed by date time group (DTG) and chronologically collated. The content of these data was subjected to open coding qualitative analysis by the researcher.

Written Data

Written data, including calculations and annotations on drawings were recorded by DTG, and compiled as closely as possible to chronological order. Typically this data took the form of changes to future drawings, and occasionally a written record of an incorrect path discovered.

Data Analysis and Results

As discussed, data from the study is was verbal (transcribed), written, and the developmental drawings generated as part of the inventive experience. I will now discuss the analysis techniques and subsequent results for each of these data categories.

Developmental Drawings

Within my context, the drawing process has always been one of simply transferring my internal visual images to paper. Beginning even before my training as an

Industrial Education teacher, and subsequently a teacher of drafting, I have used the graphic visual medium as a mechanism for capturing the mental manipulations that exist so vividly within my mind.

An advantage of the computer as a medium for capturing these developing images is in its ability to record periodic snapshots throughout the process. It was this intermittent “save” procedure that produced a wealth of material from which to study the invention process as I experienced it. During the 152 hrs of computer assisted design, I recorded 320 "snapshots," (413 total drawings) of the developing product. Appendix C contains the 91 drawings referenced in this Chapter.

The time between these snapshots varied due to a variety of factors. Sometimes I would execute a “save” immediately after completing a particularly difficult drawing task; other times I would be so deeply engrossed in the process that hitting the save button never occurred to me. On average, I saved 9.4 times per workday, with 31.33 minutes between occurrences. The largest number of saves (23) occurred during the 8.6 hours on 26 July. Since it was possible to have more than one page of drawings in process at any given time, a total of 413 drawing pages were generated, each having recorded its own contribution to the overall inventive experience. Each of the snapshots was provided a DTG, and appears on numerous spreadsheets throughout the subsequent analysis.

A review of the 413 pages of drawings indicated a significant amount of insight into the inventive experience embedded within their pages. During development, the

content of these drawings was manipulated, increased, decreased, and occasionally collapsed within its own complexity. Over time individual concepts matured, became combined with others, and ultimately resulted in the final product.

The challenge of these drawings came during attempts to understand the magnitude of embedded information, and then develop mechanisms by which it could be unlocked, exposed, and manipulated. Initial attempts to facilitate this understanding met with failure. In retrospect, the reasons appear simple. As graphic data, commonly applied analysis techniques were powerless to extract information without benefit of a translation process that would result in a comprehensible format. The volume of available data was significant and evolutionary in nature. The context, process, and product continually evolved during the drawing experience. There were variations in productivity and a question of activity versus productivity that had to be understood. Lastly, the thought processes applied during the inventive act might best be described as disjointed. Distinct pieces of the collective experience came into existence, matured, and sometimes simply disappeared for no apparent reason, only to reappear sometime in the future. All of these factors combined to result in the seemingly insurmountable task of understanding the graphical record of my experience.

I endured four failed attempts at extracting useful information from my drawings. Ultimately I came to appreciate it was my lack of understanding of the complexity of the problem, combined with perceived time pressure that largely contributed to those successive failures. With this recognition, and acceptance of the fact there were to be few

shortcuts, I proceeded to divide the problem into understandable components. This subdivision ultimately resulted in the simultaneous parallel solutions necessary to extract the sought after information. The components of this solution included establishing reference areas, or sub-elements within each DTG; developing individual part histories for each component from its introduction into the drawing package to inclusion in the final PTO submission, and to link the two together; and the generation of a drawing thread map, graphically depicting the relationship between reference areas across the inventive experience. To begin our understanding of the information, a reference baseline must be established

Time

For this research, time was the benchmark by which all occurrences were annotated and ordered, although it might be considered one of the few constants in the process. For Developmental Drawings, the DTG became the name by which each iteration of drawing was recorded. Time in a Phenomenological investigation takes on an importance well beyond its traditional role in society. An examination of the results of this research will demonstrate significant variance in the frequency at which I collected data. This variance was not the result of inattention to detail, but the product of concentrated thought processes that periodically would remove time as a component of conscious thought.

In an attempt to understand the complex interrelationships between many of the recorded actions throughout the experience, I created a time spreadsheet that reflected all

of the 92090 minutes of this project. The following are products of that spreadsheet (representative sample provided as Appendix D).

Real Time

Since this undertaking began and ended with a drawing, real time will be defined with the first minute of the project 00001, occurring when the initial developmental drawing was begun at 1806 hours on 27 May 95. References to real time within these results refer to a cumulative number originating from this point and terminating on 01 August 1995.

Project (Drawing) Time

For purposes of this research, project (drawing) time is defined as that subset of time during which actual work was taking place. It began with the first minute of the project 00001, and reflected the actual cumulative minutes that were expended working on/with developmental drawings. A representative sample of this spreadsheet is included in Appendix D.

Drawing Reference Areas

Due to the eventual complexity of the drawing package, it became impossible to comprehend, and reference complete drawing pages. This necessitated the division of most drawings into sub-elements or Reference Areas. Each of these reference areas represents a divisible component of the thought process. Each drawing was revisited and annotated with its respective reference areas. The naming convention used letters ranging from “a” to “k,” depending upon the number of reference areas available on each

drawing. Continuity between alpha designator across drawings was maximized.

Redesignation of components occurred only when logically or practically necessary. The relationship between each reference area is articulated on the Drawing Thread Map.

Drawing Thread Map

The next phase of my analysis required the development of a graphic representation of the relationships that existed between the drawing pages and individual reference areas contained thereon. This was completed and is provided as Appendix E. A review of this map indicates numerous instances of parallel, developmental activities that periodically combine and separate. Additionally, concepts are spawned, and periodically become extinct.

Several aspects of these occurrences are of interest to our understanding of the inventive experience. They include an analysis of those reference areas that receive input from drawings other than its immediate predecessor. This occurred approximately 28% of the time, with the average material brought forward 8.4 real-time days, or 29.52 project hours. (Analysis on these aspects of the Thread Map is provided as Appendix F.)

Part History

Convinced of the valuable data embedded in the drawings, and unencumbered by an appreciation for the complexity and magnitude of the extraction process, I set about developing a mechanism by which I could articulate a part "history" for each of the seventy-one parts described in the Patent Application.

My analysis of the drawings included reviewing and documenting the changes that

occurred within each reference area of each drawing for the entire 152 hours of the project. Since numerous parts appeared on most drawings, I felt it was necessary to record not only the individual parts receiving attention, but the total number of items associated, no matter how remotely, with the process. I reasoned that if a part was visible on the drawing under consideration, subject part existed within the context of that drawing and should be included within the data captured.

Since changes to the drawings took any one of a number of forms, it became necessary to develop a series of classifiers that would allow the organization of these occurrences into easily manipulatable formats. To that end, I developed a designator for the part history information of interest. My annotation indicated when a part was introduced (I), every time it changed (C), whenever it was moved for substantive reasons (M), every time an additional identical part was added to a drawing (A), and whenever a part was reintroduced (R), meaning it had been dropped for some reason, and I found it necessary to reinstate into the process. Collectively, these are the activities that address introduction, and development of a part. For the large number of parts on any drawing remaining unchanged, I added a final category, "U." As part of a fifth iteration of this process, I added additional categories for the part numbering process (N), and included a designator to distinguish between prototype and nonprototype changes. These categories included TD for prototype dimensioning, TC and TU for prototype change and unchanged, respectively.

I subsequently reviewed every reference area on every page of drawings and listed

the included parts. Each part was assigned the appropriate code. This process consumed almost as much total time as the actual inventive experience, encoding 18404 parts in 1213 reference areas on the 413 developmental drawing pages. From these data, the Part History Matrix was generated.

Part History Matrix

To organize these data into an understandable format, I created a Part History Matrix, a spreadsheet approximately 100 columns wide by 1300 rows long. Each reference area, within its drawing page and DTG, was represented on a horizontal row. Each part number included on the PTO Application received a vertical column. This arrangement provided the opportunity to annotate the characteristic of each part within each reference area from its inception throughout the duration of the inventive experience. Additionally, the Part History Matrix provides duration (in minutes) of each DTG designator. The Part History Matrix is included as Appendix G.

With the compilation of part history data, reflecting the presence and status of each part in each reference area on each drawing page, it is possible to manipulate the data and gain insight into a variety of characteristics about each part. From these data, it was possible to generate the Part History Roll-up Matrix.

Part History Roll-up Matrix

The Part History Roll-up Matrix is the combined analysis of the various categories (I, C, M, A, R, N, TD, TC & TU, U) by reference area, drawing page and DTG. This assemblage of information allows a variety of views into the Developmental Drawings.

Aggregating the I, C, M, A, R, N, TD, TC, the categories provide a “change” function, while combining the TU and U provides insight into those aspects of each Reference Area that remained unchanged. Both categories and their total were calculated by Reference Area and DTG. Additionally, the changed and unchanged activity per minute of experience were also calculated, and are included. Last, the ratio of changed to unchanged by DTG was determined. The Part History Roll-up Matrix is included as Appendix H.

Results of the Part History Roll-up Matrix total drawing activity were plotted. Table 1 provides the result of this analysis. Although there was no conscious attempt to in any way regulate or control the inventive experience, a review of Table 1 would indicate potentially five separable activity periods within the overall experience window.

The first, from 27 May - 4 June, was the initial phase of the project, a period during which a significant amount of progress was completed. The longest day in this period was 559 minutes on 4 June with the remaining 34.41 hours spread over the previous days. June 2, was the shortest day, with 2.116 hours invested.

Phase two began on 7 June and continued on the 9th, 10th, and 11th, with 1.88, 4.1, 11.91, and 6.83 hours respectively. During this phase, the development process shifted from a theoretical to a practical one, with the development of interim prototype drawings. While these items, in and of themselves, were of little value they did serve to refine (read: simplify) my thought processes toward a more affordable, and producible device.

Table 1 - Total Drawing Activity by Day

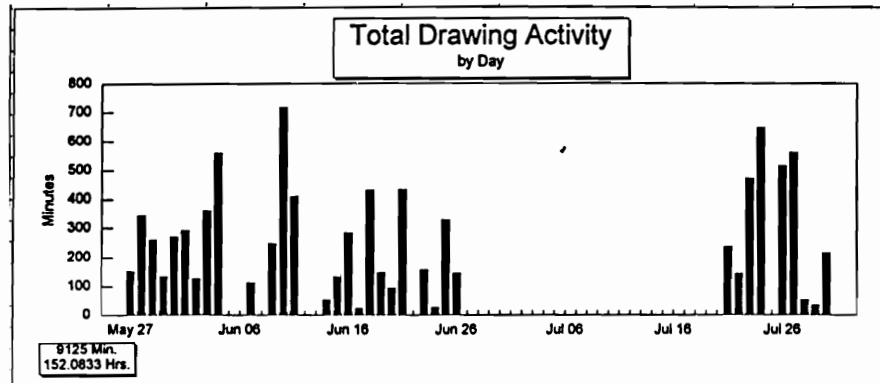


Table 1							
Sun	Mon	Tue	Wed	Thurs	Fri	Sat	
						May 27	
Total Time: Minutes						152	
Hours						2.533333	
May 28	May 29	May 30	May 31	Jun 01	Jun 02	Jun 03	
346	259	135	270	293	127	363	
5.766667	4.316667	2.25	4.5	4.883333	2.116667	6.05	
Jun 04	Jun 05	Jun 06	Jun 07	Jun 08	Jun 09	Jun 10	
559	0	0	113	0	246	715	
9.316667	0	0	1.883333	0	4.1	11.91667	
Jun 11	Jun 12	Jun 13	Jun 14	Jun 15	Jun 16	Jun 17	
410	0	0	55	132	284	25	
6.833333	0	0	0.916667	2.2	4.733333	0.416667	
Jun 18	Jun 19	Jun 20	Jun 21	Jun 22	Jun 23	Jun 24	
430	147	95	432	0	156	28	
7.166667	2.45	1.583333	7.2	0	2.6	0.466667	
Jun 25	Jun 26	Jun 27	Jun 28	Jun 29	Jun 30	Jul 01	
327	145	0	0	0	0	0	
5.45	2.416667	0	0	0	0	0	
Jul 02	Jul 03	Jul 04	Jul 05	Jul 06	Jul 07	Jul 08	
0	0	0	0	0	0	0	
0	0	0	0	0	0	0	
Jul 09	Jul 10	Jul 11	Jul 12	Jul 13	Jul 14	Jul 15	
0	0	0	0	0	0	0	
0	0	0	0	0	0	0	
Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 22	
0	0	0	0	0	238	144	
0	0	0	0	0	3.966667	2.4	
Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul 29	
472	648	0	516	562	53	34	
7.866667	10.8	0	8.6	9.366667	0.883333	0.566667	
Jul 30	Totals:	5/27 - 6/4	6/7 - 6/11	6/14 - 6/26	Sub Total	7/21 - 7/30	Grand
214		2504	1484	2256	6244	2881	9125
3.566667		41.73333	24.73333	37.6	104.0667	48.01667	152.0833

The third phase, beginning on 14 June and ending on 26 June, completed 37.6 hours of drawing work. The longest day of the period was June 18, with 7.166 hrs. By 27 June I believed the project to be 95% complete. It was at this point that I met with Dr. Marcie to discuss a variety of packaging and presentation issues surrounding the results.

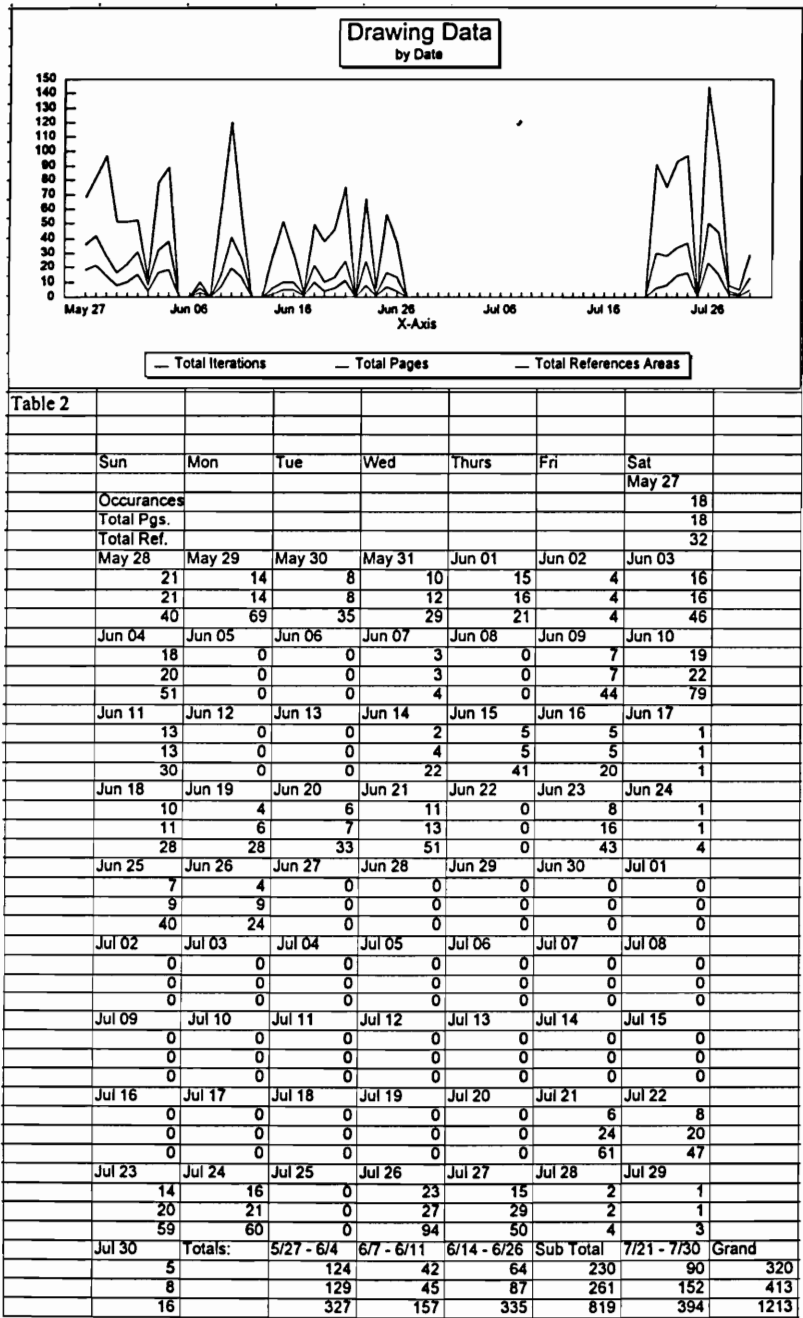
The fourth phase extended from 28 June until 21 July. During this time I participated in a brief family vacation and attended to the critical illness of my mother-in-law. During this time, I transcribed several early audio tapes; generated the initial draft of the drawing spreadsheet; reviewed the PTO rules for drafting; and performed computer maintenance. All of these activities were perceived to be outside the scope of the inventive experience, and did not contribute to any subsequent development or modification during phase five. During this period, I perceived no difficulty in meeting my 01 Aug. filing date to the PTO.

The final phase totaled 28.01 hours that for drawing purposes ended on 30 July. It was during this phase that many decisions of the past were revisited, and questions about the "real world" viability of the device were addressed. The longest day during this period was 24 July with 10.8 hrs, followed by 27 July with 9.33 and 23 July with 7.866.

From the Part History Roll-up Matrix, I next generated Table 2, the Drawing Data Chart. Insight into the total iterations, or DTGs, along with the total drawing pages and total reference areas generated each day of the inventive experience.

In an attempt to understand my rate of activity during the experience, Tables 3a-d provide the drawing changes (again the I, C, M, A, R, N, TD, TC aggregated) per minute

Table 2 - Drawing Data by Date



across the DTGs. Each sub-table represents one of the four activity periods within the inventive experience. Further attempts to display and understand the frequency patterns associated with the experience caused the generation of Table 4, which includes the changed and unchanged activity for, in this case, 01 June 95. Although interesting to observe, little of apparent consequence was derived from this undertaking.

Unwilling to allow the escape of the most remote possible relationship, an analysis of the individual changes across the four activity periods was also conducted. The results, Table 5, provide little obvious indication of relevant insight into the experience.

Part Sort Matrix

Given the limited insight provided by the aggregate data, my search for embedded meaning continued. From the Part History Matrix I extracted a Part Sort Matrix. This view was the accumulated activity for each part, by category, across the entire experience. The Part Sort Matrix allows appreciation of those parts that for yet to be determined reasons, were the most and least active during the experience. An analysis of the most and least active parts indicated that those parts comprising the top 10% of activity (P/Ns 90, 96, 128, 84, 72, 56, & 130) accounted for 20% of total changes and 22% of total activity (changed and unchanged) of the experience. Those parts comprising the least active 10% (P/Ns 104, 45, 97, 95, 107, 75, & 73) provided only 2% of the total changed activity and .5% of the total changed and unchanged activity across the experience. Top level data from the Part Sort Matrix is provided as Appendix 4-I.

Table 3a - Drawing Changes by Time Group (27 May - 4 June)

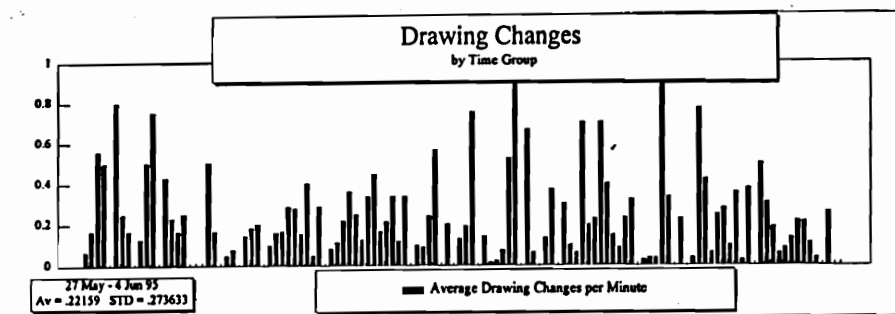


Table 3b - Drawing Changes by Time Group (7-11 June)

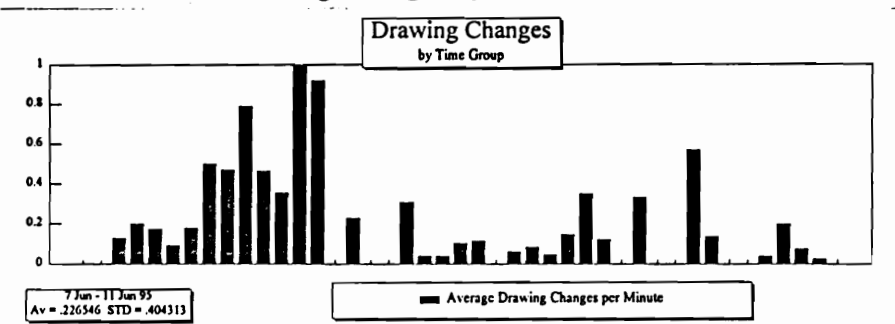


Table 3c - Drawing Changes by Time Group (14-26 June)

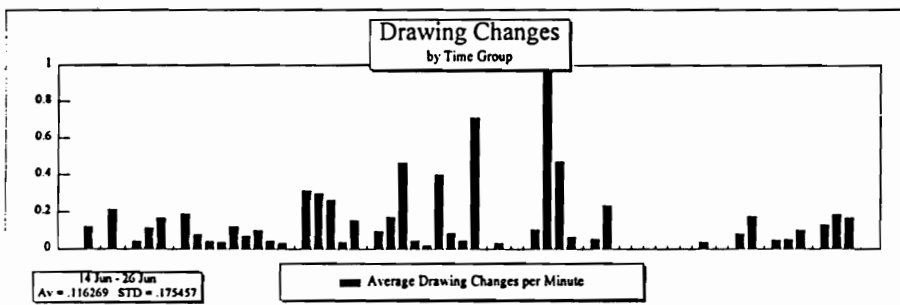


Table 3d Drawing Changes by Time Group (21-30 July)

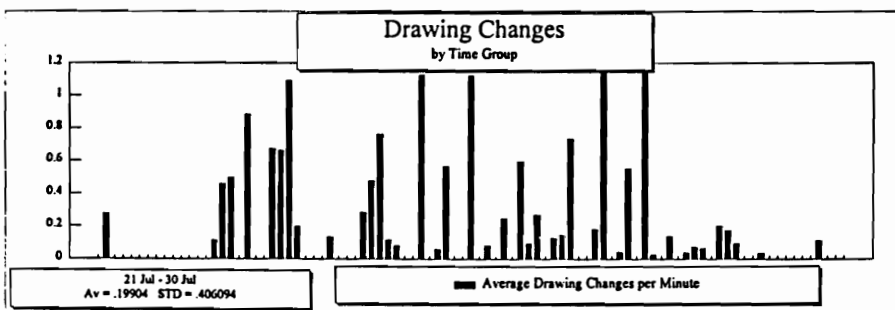


Table 4 - Changes per Minute (01 June 95)

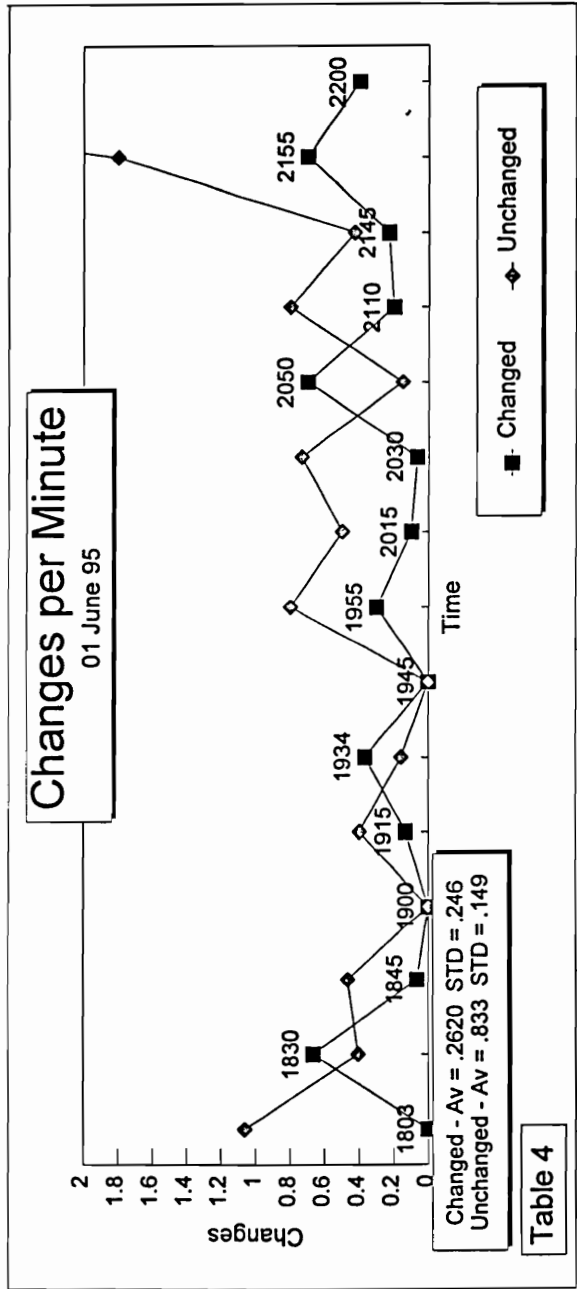
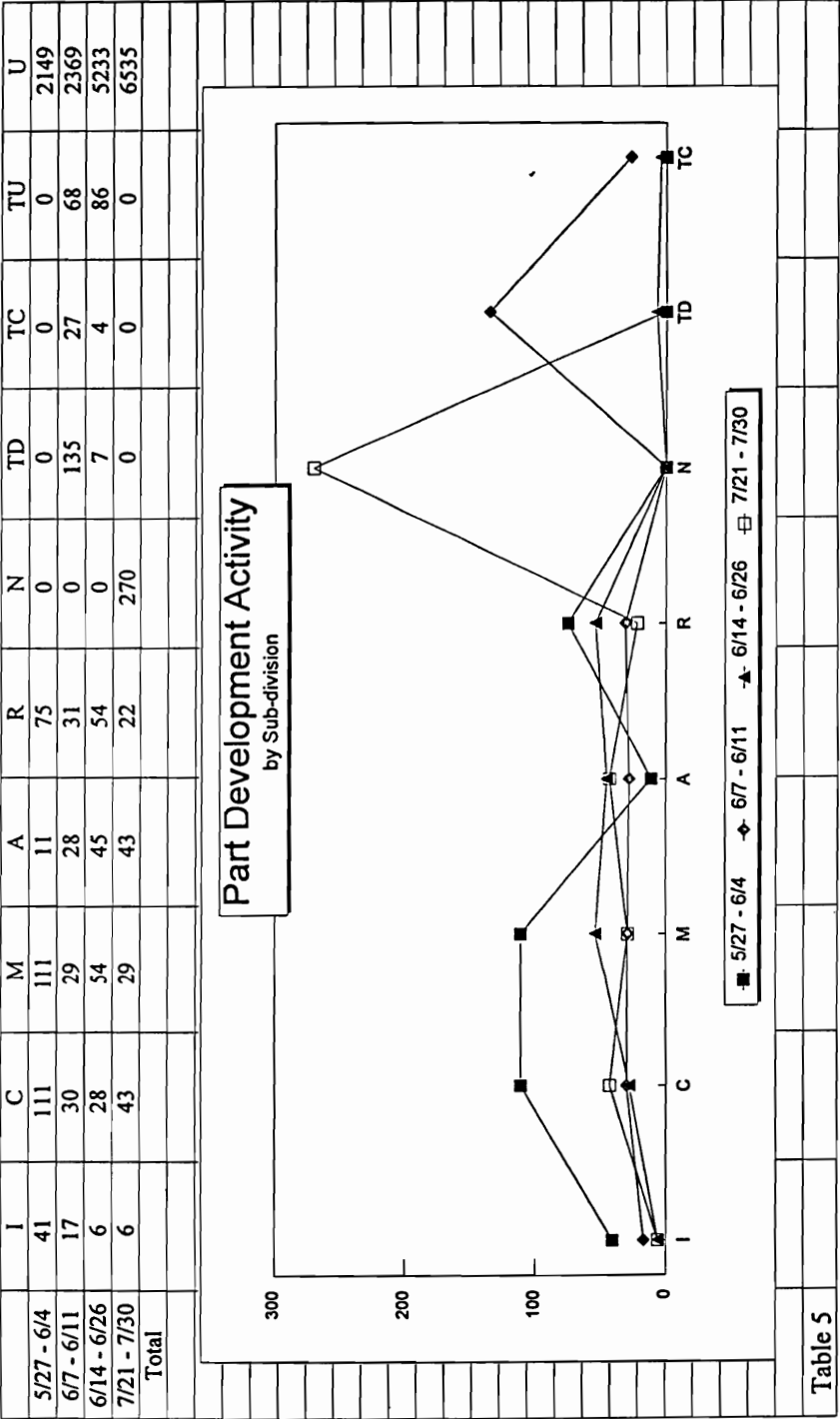


Table 5 - Part Development Activity by Subdivision



Seventy-one parts are included in the part history matrix. The total manipulative activity, including all I, C, M, A, R, N, TD, and TC categories was 1238, with an average of 17.19 times with Standard Deviation of 11.52 per part. Over the period of data collection, the available but unchanged total was 16036, with an average per part of 222.72, with Standard Deviation of 142.4. Combined, these provide 16961 part appearances over the 413 drawings, for an average of 41.06 parts per drawing.

The part experiencing the most manipulative and unchanged activity was P/N 90, the upper housing. It was addressed a total of 46 (I, C, M, A, R, N, TD, and TC, combined), and remained unchanged 588 additional times. I believe this history to be the result of its early introduction into the process (27 May) and its criticality to the overall design. It provides the frame and structural integrity for attachment of the cap, and fingerguard assemblies.

An analysis of the top and bottom ten percent of the population found an average manipulation of 41 and 1.28 times respectively. Items in the upper band included P/N 90, the upper housing; P/N 128, the lower housing; P/N 21, a highly visible portion of the center post (20); P/N 126, paint ball; P/N 96, the fingerguard; and P/N 64, a safety interlock handle. The notable inclusion in this group is P/N 64, which came into existence much later than the remainder of the band, and whose manipulation might be an indication of the attention paid to safety within the overall design effort.

Although my understanding of the Developmental Drawings was at a new high, and I had acquired insight into the major mechanisms that existed within the experience,

there were still aspects of the process I wanted to explore and understand before I began qualitatively reviewing the verbal data.

Cumulative Change Matrix

The Cumulative Change Matrix provides the cumulative percent complete by coded category for each of the DTGs. Included as Appendix 4-J, the insight provided by this analysis is useful for establishing rates of completion across the various aspects of the experience. By example, Table 6 provides a comparison of the rate of changed to that of unchanged across project life. It might be expected that the percentage of changed outpaced the unchanged in the earlier stages of the project, with the gap closing as completion neared. At no point did the unchanged surpass the changed, indicating that for this level of scrutiny, productivity was typically positive across the experience.

Subdividing the categories further, it is possible to see how each component of the changed and unchanged categories contributed to the completion the project. Table 7 provides insight into these characteristics.

Table 8 further limits the components to those contributing a significant portion to the changed category. Display of these individual components is across the five phases of the experience. Analysis of this data would indicate that significant portions of the development were completed by the end of Phase 3. It is also interesting to note that more than 60% of the part introductions, changes and movement were completed by the end of the first phase. The rate of change obviously slowed during Phase 2, with moderate acceleration during Phase 3. Phase 5 provided the final 10% of the total

Table 7 - Component Cumulative Changes as Percentage of Total Over Invention Lifecycle

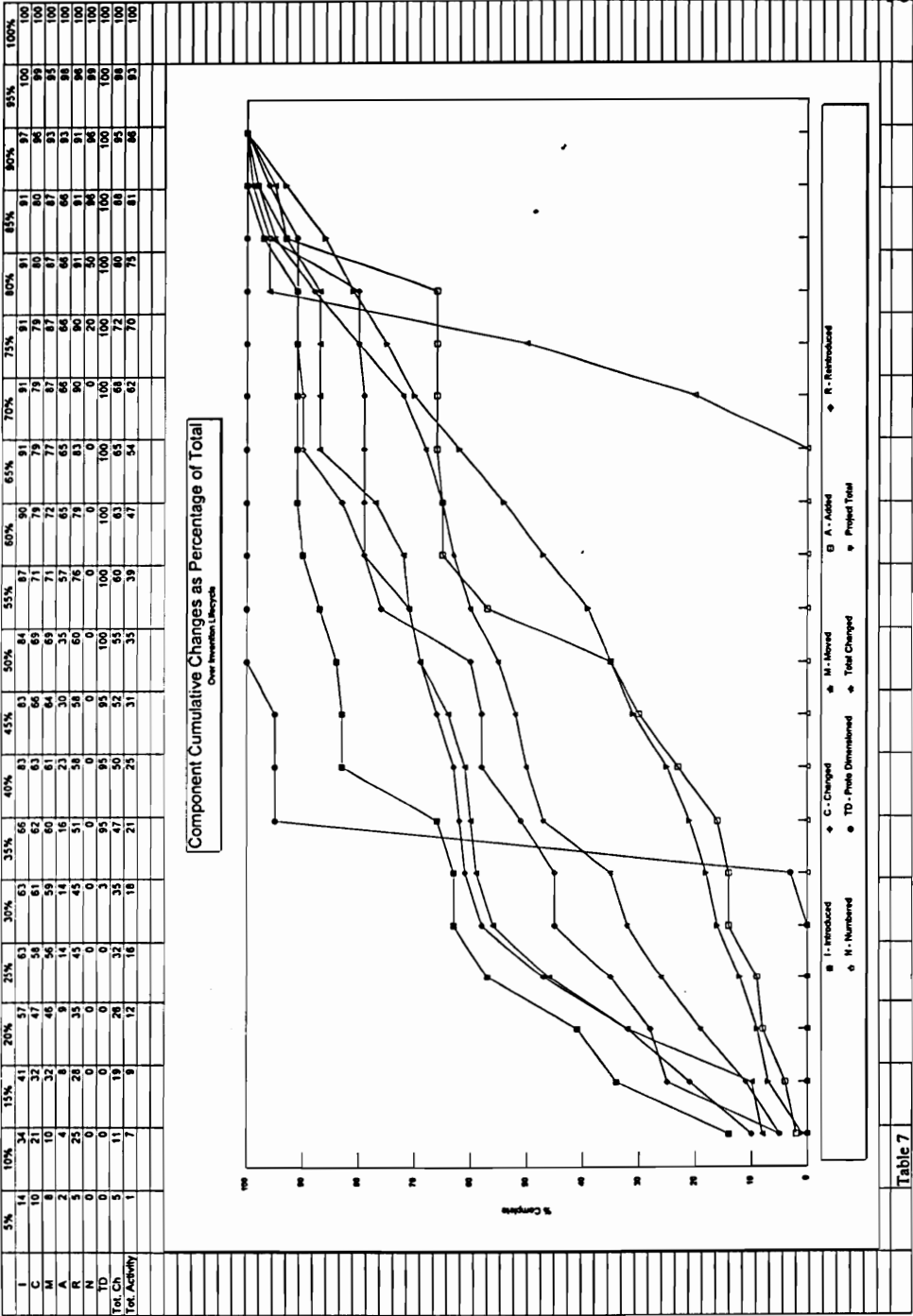
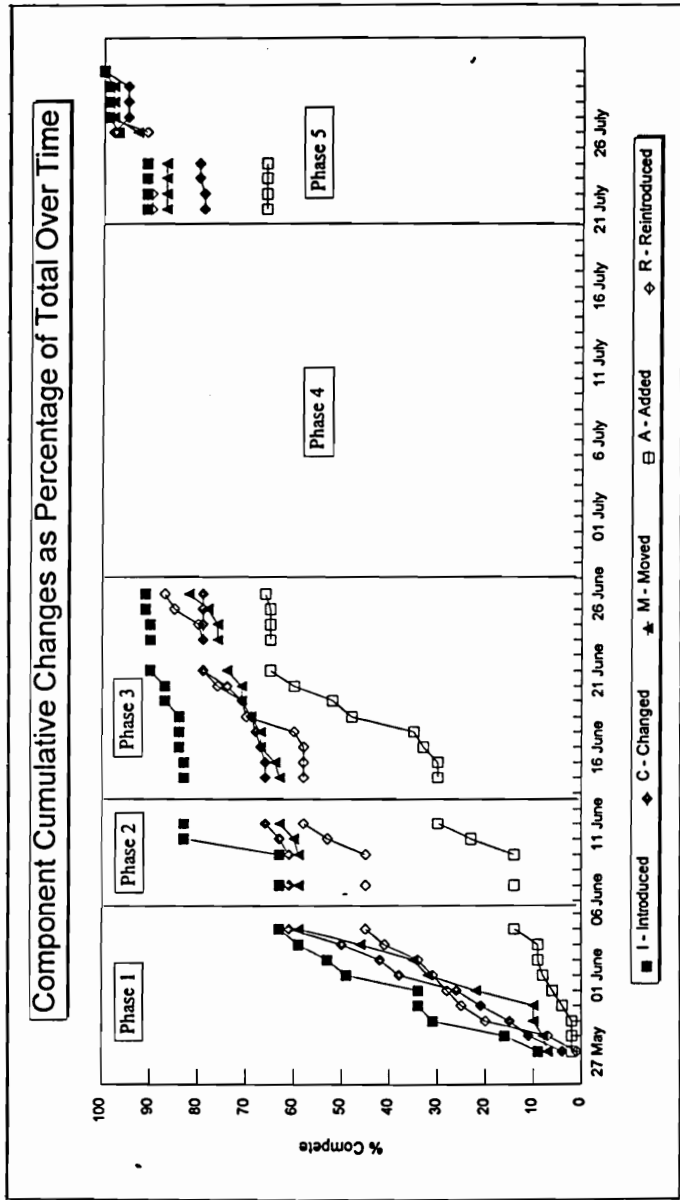


Table 8 - Component Cumulative Changes as Percentage of Total Over Time



activity.

The final aspect of Developmental Drawing analysis centered around the safety aspects of the device. In today's environment, product safety is a characteristic that must be designed into every product that possesses commercial viability. This device is no exception. In an attempt to understand when and how safety was reflected in the Developmental Drawings during this experience, I identified sixteen parts to be safety "critical," meaning they were essential to precluding injury to users. These parts included 26, 28, 54, 56, 58, 62, 64, 66, 96, 100, 103, 104, 110, 112, & 114. In addition, I designated seven parts as safety "related," contributing to the overall safety of the grenade. A Safety Matrix was developed to better understand the evolutionary history of these safety items.

Several of the seventy-one parts contained on the history matrix could be classified as safety related (contributing to overall safety), or safety critical (precludes injury) to the design and function of the device. Since the safe handling and functioning of the grenade is of paramount importance, I compiled a list of these parts, the means, and standard deviations of their activity/nonactivity rates as subgroups, and against the population as a whole.

Safety Critical items included P/N 26, the centerpost interlock cutout; P/N 28, thru-hole for actuator ball; P/N 54 -58, components of the grenade pin; P/N 62 - 68, the safety interlock mechanism; P/N 96, the fingerguard, P/N 100 the fingerguard loading door; P/N 103-4, loading door interlock, P/N 110, 112, and 114, housing and components

of the safety interlock mechanism. Combined, the safety critical items provided 328 total manipulations and 4096 unchanged views. Combined they accounted for 26.5% of total project manipulations and 25.5 of the unchanged views.

Safety Matrix

The Safety Matrix (Appendix 4-K) provides complete details for the safety critical as well as safety related items across the inventive experience. Table 9 provides a comparison of the safety critical to safety related parts across the life cycle. It is interesting, that although initially similar in their behavior, those parts perceived as safety critical outpaced the related items during the last 50% of the experience.

A comparison of the aggregate safety and non-safety parts changed across the project life cycle is provided in Table 10. Although initially lagging non-safety changes, the two curves are closely aligned during the last 25% of the experience. I believe this to be indicative of the increased attention focused on safety during the latter stages of this product's development.

Verbal Data

Unlike the process of searching for meaning in the verbal descriptions of others', coding one's own thoughts provides an opportunity to assign the obvious recalled (subject to their recognized inaccuracies) experience. The challenge comes when as a researcher, one attempts to dissociate oneself from the remembered experience and focus on the content of the material.

The product of 152 hours of Developmental Drawings resulted in a literal

Table 9 - Relationship of Safety Critical and Safety Related Over Project Life

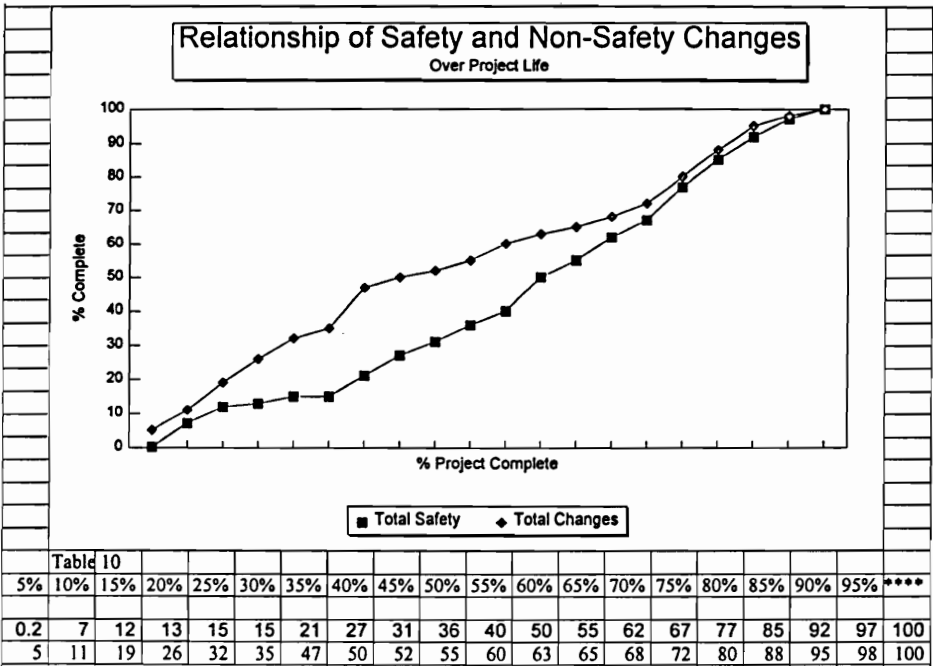
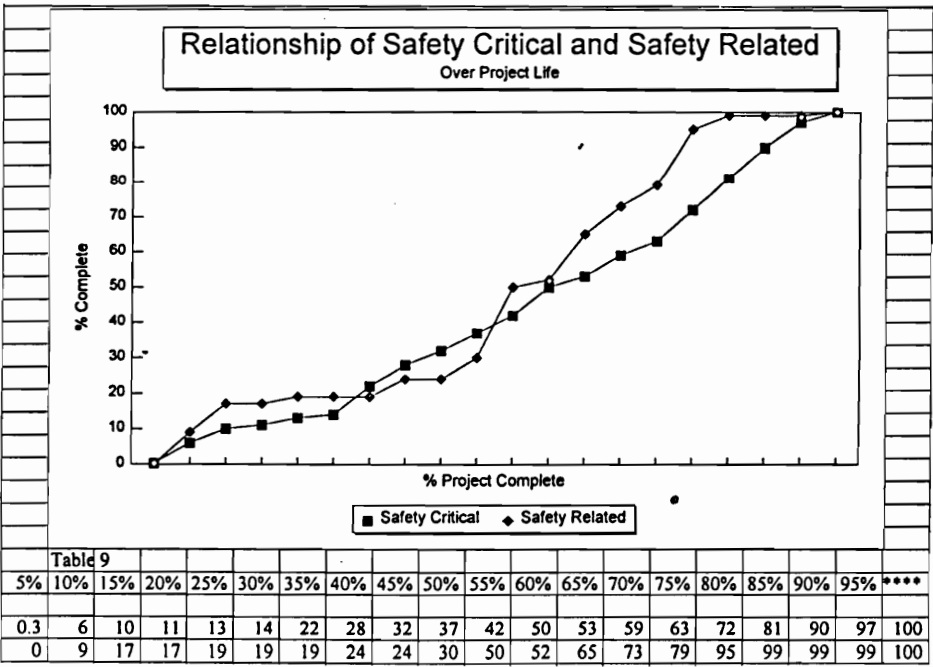


Table 10 - Relationship of Safety and Non-Safety Changes Over Project Life



mountain of recording tape and the seemingly endless hours of transcription. In an attempt to understand the content while realistically dealing with magnitude of material, I used the Developmental Drawing analysis as the starting point for selecting 10 samples of verbal data from across the inventive experience.

Selection of Samples

The procedure for selecting subject samples was a rigorous one. My intent was to select a cross-section of the experience that contained the spectrum of the available material. Due to a near linearity of progress over time, as evidenced by several previous exhibits, I constructed a chart depicting Completion as a Percentage of Total (Table 11). This chart displays the cumulative changed line for the duration of the inventive experience and became the basis for determination of the four productive and one unproductive phase. Also, from these data, came the samples deemed to represent my overall activity. Samples were selected from all four productive phases. Two each from the first and second phases (Tables 12 and 13 respectively), and three each from Phase 3 and Phase 5 (Tables 14 and 15).

Sample 1 taken from 31 May 95, provides an increasing incremental slope over time. Sample 2, from the first through the third of June, is a much more abrupt increase in changed material than its predecessor. Sample 3, on 9 June, is a progressive stair step, with Sample 4 a near flat segment preceding a significant increase in changed activity. Sample 5 on 20 June (Phase 3), is some minor activity preceding a marked increase in change. Sample 6, on 21 June, is similar to Sample 5; however, the rate of increase is

Table 11 - Completion as Percentage of Total

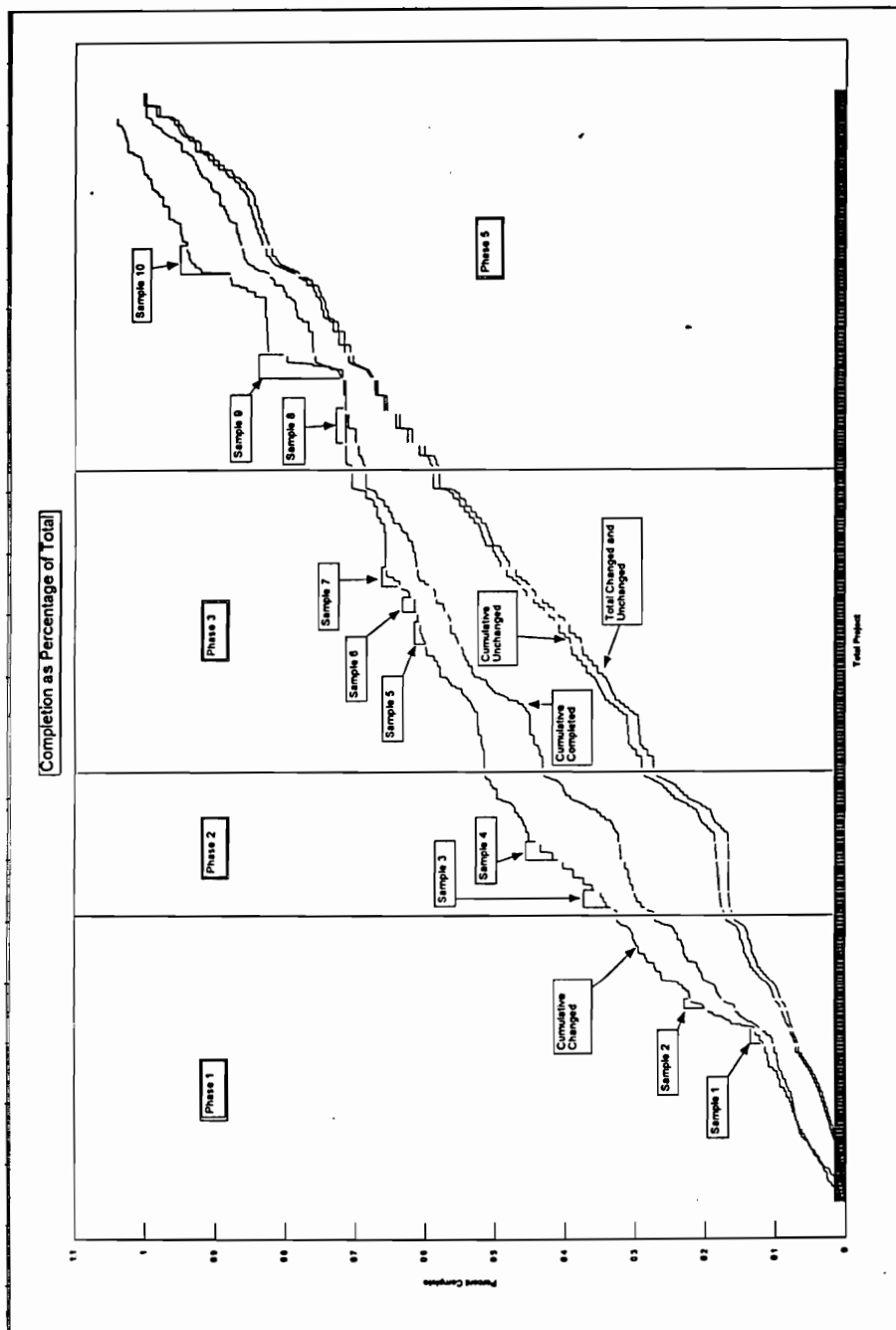


Table 12 - Completion as Percentage of Total (Phase 1 Examined Areas)

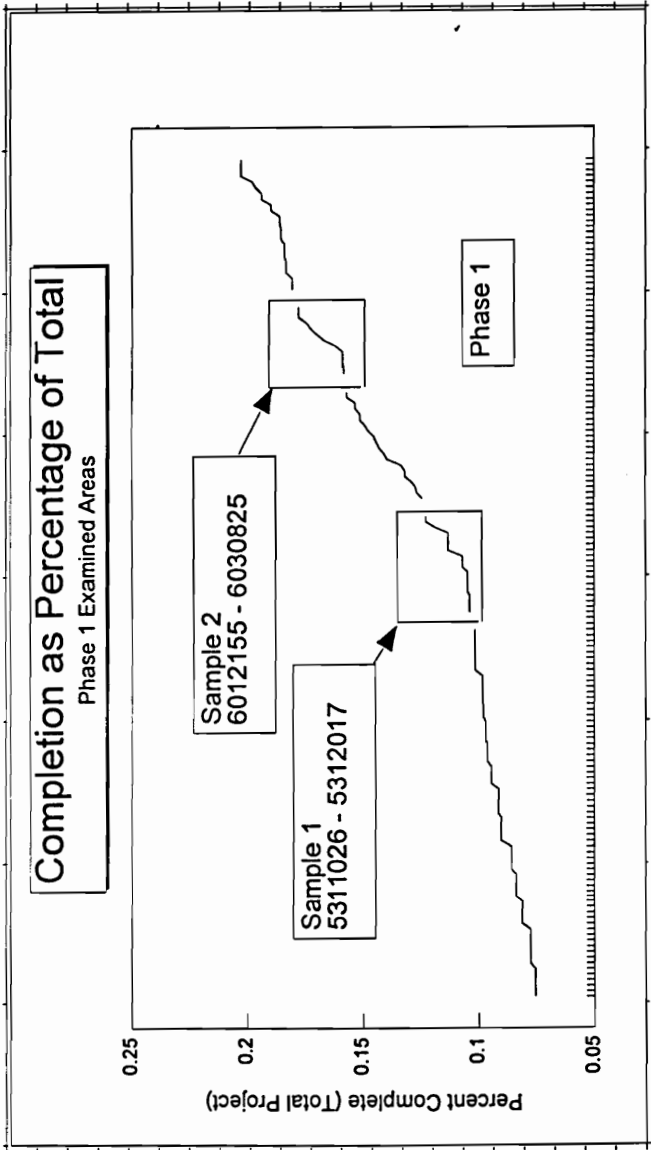


Table 13 - Completion as Percentage of Total (Phase 2 Examined Areas)

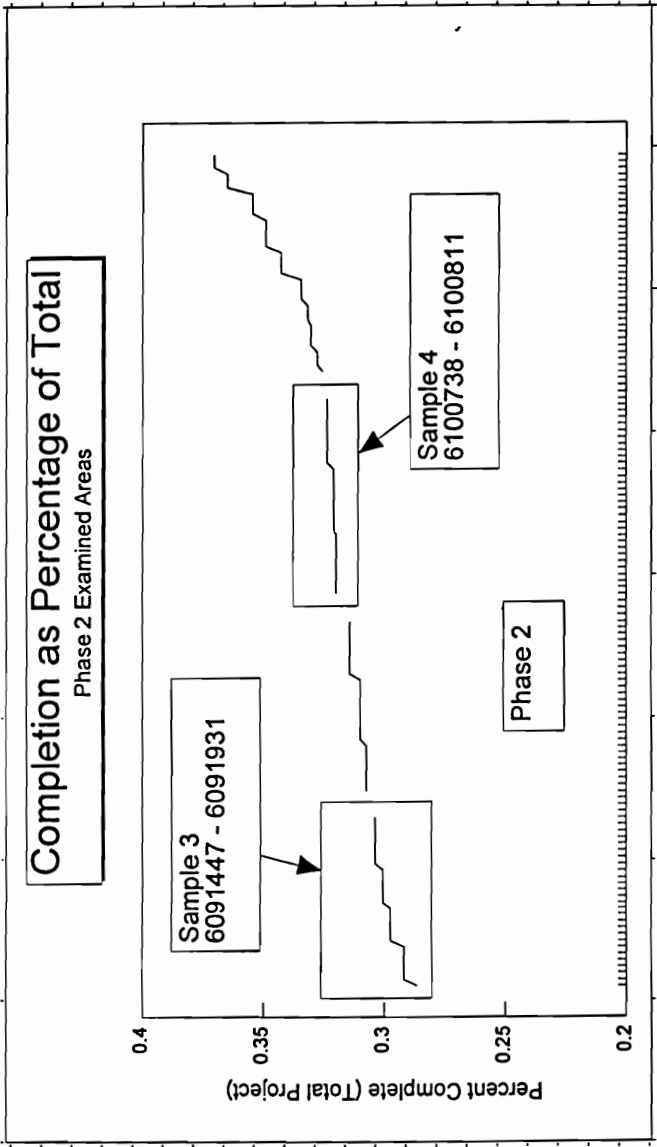


Table 14 - Completion as Percentage of Total (Phase 3 Examined Areas)

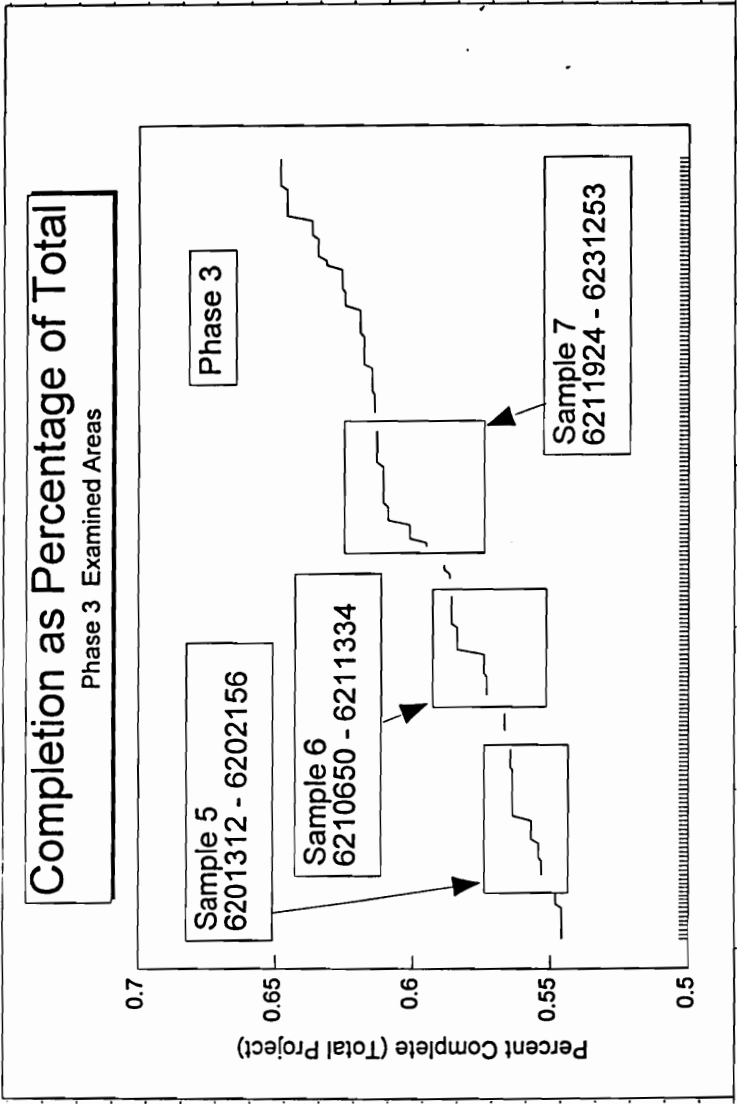
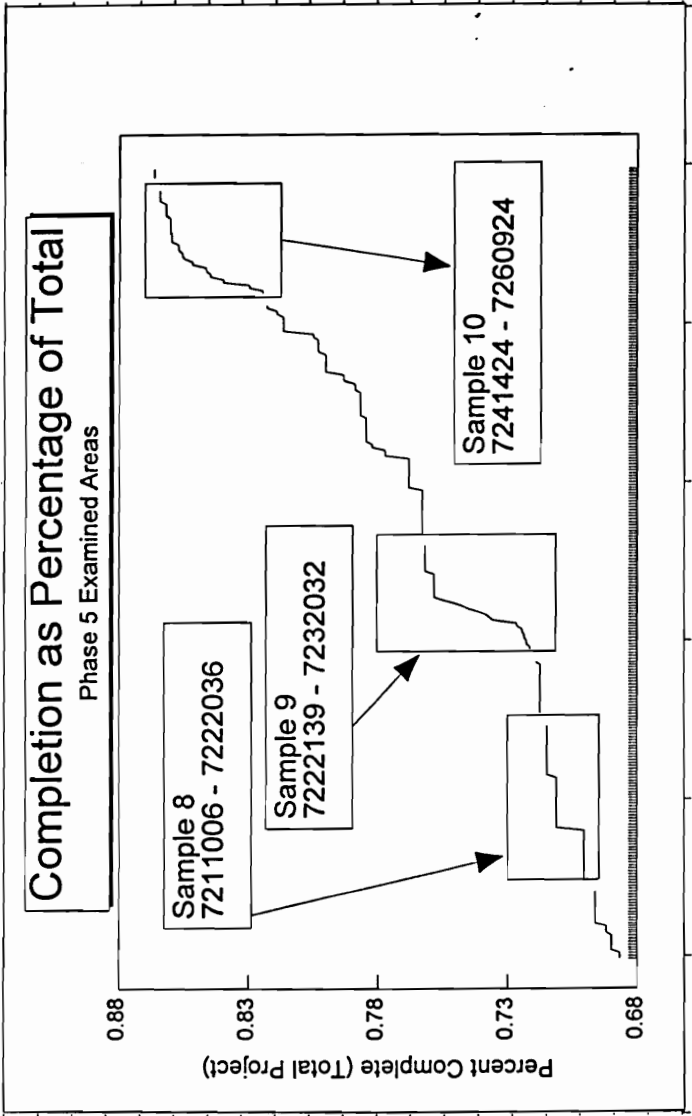


Table 15 - Completion as Percentage of Total (Phase 5 Examined Areas)



more abrupt and higher. Sample 7, on 21 through 23 June, is a flurry of activity prior to a gently increasing slope. Samples 8 -10 occurred in Phase 5 with sample 8, on July 21 and 22 being first a large, then a smaller step that preceded Sample 9, on 22-23 July that had a significant increase in activity. The final Sample, number 10, occurs within the final few days of the project and provides for a rapidly increasing, then gradually decreasing, rate of change.

The initial selection of my samples was a function of their configuration and relationship to other aspects of the experience. In order to make intersample comparisons, I also needed to understand and articulate their individual characteristics. To do this, I calculated the slope, or rate of change over reference area percent complete, and displayed them on Table 16. They were subsequently reordered on Table 17, Relative Slopes of Samples.

The relationship of activity to time is an important consideration when trying to understand the total inventive experience. Since I had eliminated time as a variable during initial sample selection, I examined the samples reinserting the time factor. The recalculations are provided in Table 18. As expected, a variance exists between the two procedures. Table 19 provides the value ordering of the Relative Slopes of Samples as a ratio of changes per minute. A graphical comparison was undertaken in Table 20, using the change per reference area as the leftmost y-axis, with changes per minute displayed on the right y-axis. Both curves are ordered and provided as Table 21. A review of all possible numerical curves across the inventive experience indicated that the verbal

Table 16 - Relative Slopes of Samples (Ratio of Change per Reference Area)

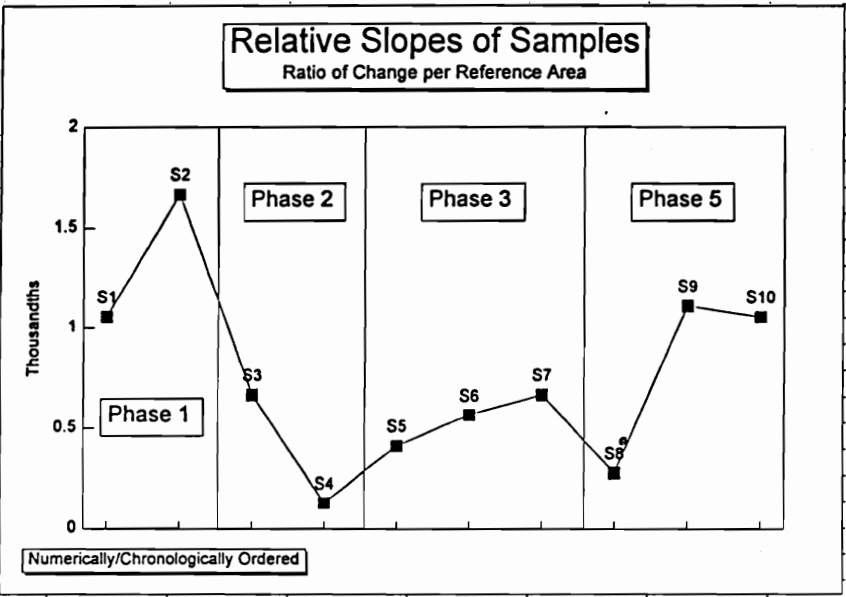
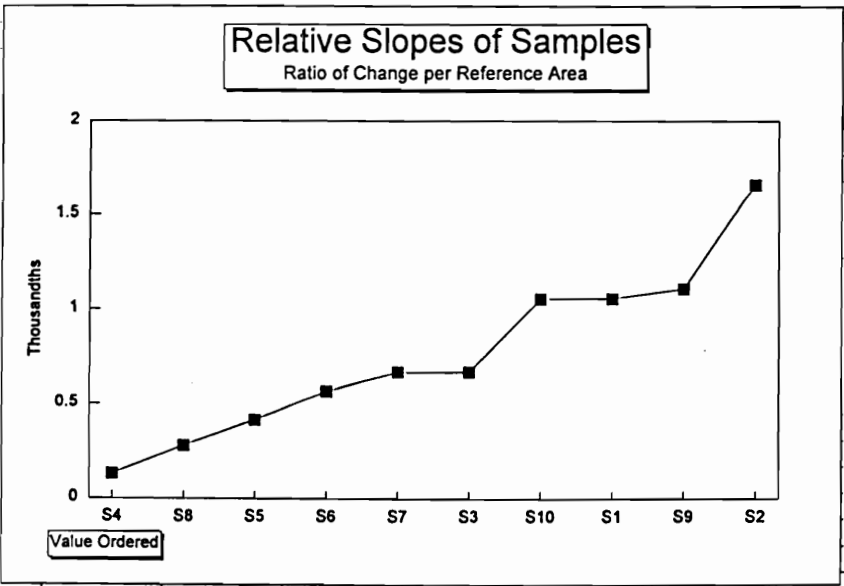


Table 17 - Relative Slopes of Samples (Ratio of Change per Reference Area)



sample set selected was indeed representative of a significant percentage of all possible slope states; however, due to the arbitrary nature of their selection, their frequency was not representative of the population as a whole. As might be expected from the sample selection procedure, several of the curves occur numerous times during the total experience, while others occur but once. Since I was interested in examining the range of all possible curves, my sample set was indeed appropriate.

The ten samples were subjected to Open coding, resulting in labeling and subsequent Categorizing, of the verbal data. This procedure was accomplished through the use of a word processor and data base. The transcripts of the verbal recordings are contained in Appendix 4-L, along with the results of open coding and categorization. Results of the open coding will now be discussed within the context of each samples selection criteria.

Sample 1

Sample 1 is the time frame between 1026 and 2017 on Wednesday, 31 May 95. Total project time for the sample was 198 minutes and resulted in 6 DTGs, 7 drawing pages and 18 reference areas. The slope of sample one was .000096, which was eighth in total value as provided on Table 17. With respect to the remaining samples, this sample continued a significant number of changed parts, 20 in all, comprised primarily of Movements (12 ea.), followed by Changes (4 ea.) and Additions (3 ea.). The remaining change was the reintroduction of part number 28. Of immediate concern, across the sample period, was the design and functioning of the actuator mechanism. This was a

Table 18 - Relative Slopes of Samples (Ratio of Change per Minute)

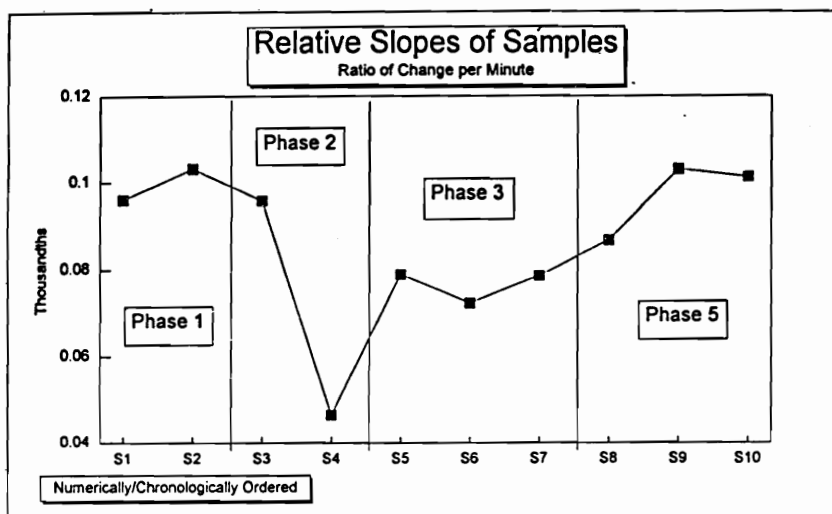


Table 19 - Relative Slopes of Samples (Ratio of Change per Minute)

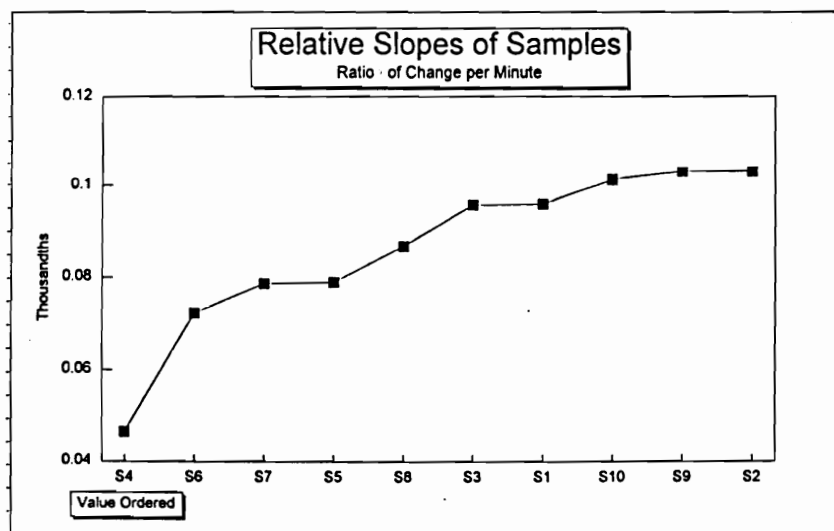


Table 20 - Relative Slopes of Samples (by Phase)

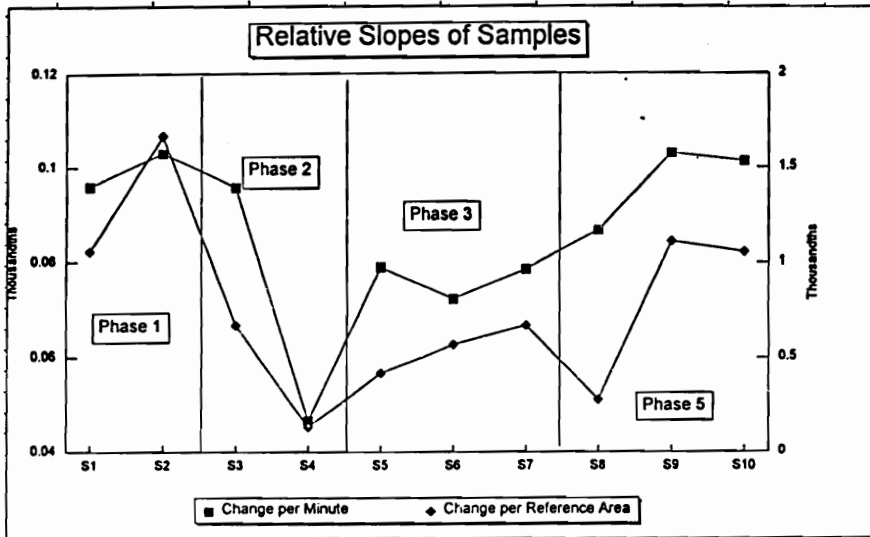
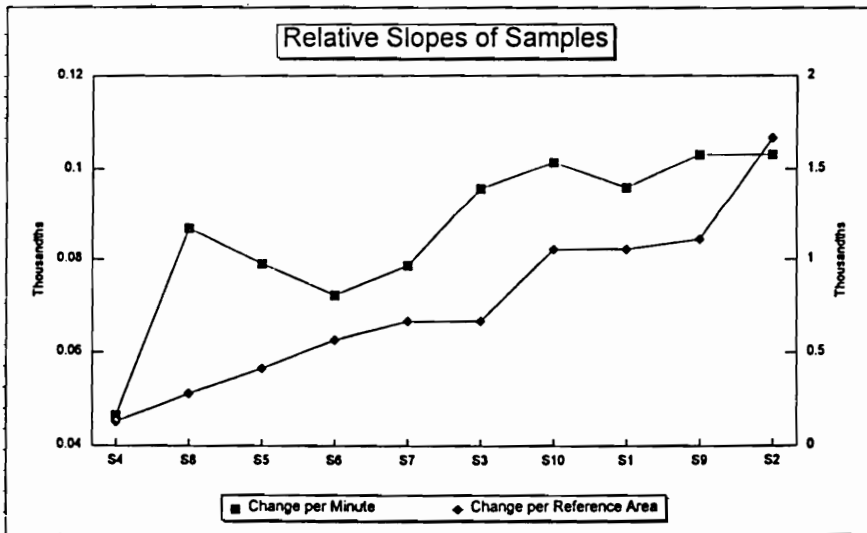


Table 21 - Relative Slopes of Samples (by Phase)



particularly sticky problem that would plague the development process, initially settling for a recognized marginal solution while understanding and maturation of the directed thought processes continued. Analysis of the 1169 words contained within Sample 1's transcript produced 14 labels that collectively occurred 56 times (Appendix 4-M). The most frequent label, being assigned a total of 15 times was "function," which connotes the operation of the developing grenade. This would be consistent with the difficulty I was having refining the actuator mechanism. The next two labels, each having seven occurrences were "design" and "manipulation." Design is closely associated with the label function, and represents the aesthetic aspects of the device. Manipulation is the interface with the computer hardware and software that supported the undertaking. "Emotion," occurring five times, and "visualization," being labeled four times rounded out the top five labels for Sample 1. The fourteen labels of Sample 1 were sorted into 8 categories, including Operation (17 ea.), Intellectual (12 ea.), Appearance (7 ea.), Automation (7 ea.), Emotional (6 ea.), Environmental (5 ea.), Automation (1 ea.), and Physical (1 ea.).

Sample 2

Sample 2, from the first through the third of June, has a much more abrupt increase in changed material than its predecessor, and is the final sample selected from Phase 1 of the inventive experience. The Sample 2 timeframe began at 2155 hrs. on Thursday, 1 June, and concluded at 0825 hrs, Saturday, 3 June. The total project time for the sample was 194 minutes and resulted in 8 DTGs, 8 drawing pages, and 12 reference

areas. The slope of sample 2 was .000103, which was tenth, or highest among the selected samples (Table 17). With respect to the remaining samples, Sample 2 contained the highest number of changed parts, for a total of 33, composed of Changes (14), Introductions (7), Movement (6), Reintroductions (5), and Additions (1). Perhaps best described as a period of refinement, the period of Sample 2 attempted to provide order and viability to the preceding wave of inventive activity. It was a time of focus and increased understanding of the numerous concepts and ideas that had been rather haphazardly recorded during previous sessions. This can be seen in the relative formality of the drawings produced and the plethora of new part introductions, each a refinement of already existing parts. It was a time of excitement, enthusiasm, and accomplishment. It appeared obvious that the grenade would be successful, even though numerous design, operation and Producability challenges lay ahead. In retrospect, it was the beginning of the intellectual termination of Phase 1. Analysis of the 2282 words contained within Sample 2's transcript produced 29 labels that collectively occurred 106 times (Appendix 4-M). The most frequent label, assigned a total of 19 times was "emotion," which illustrates the joy and enthusiasm of the period. Emotion was closely followed by function (18 ea.), and design (10 ea.), which is indicative of the interwoven relationship between how it worked; how it looked; and how I felt about the grenade at that time. Manipulation (9 ea.), Time (6 ea.), and the Computer (5 ea.), rounded out the top six labels. The distinction between manipulation and computer is frequently a clouded one, dealing with idiosyncracies and limiting constructs embodied in the medium. The 29

labels of Sample 2 were sorted into eight categories, including

Operation (25 ea.), Emotional (22 ea.), Intellectual (22 ea.), Automation (14 ea.), Appearance (10 ea.), Environmental (7 ea.), Physical (4 ea.), and Creativity (2 ea.).

Sample 3

Sample 3 is the timeframe between 1447 and 1931 on Friday, 09 June 1995.

Total project time for the sample was 188 minutes and resulted 5 DTGs, 5 drawing pages and 27 reference areas. The slope of Sample 3 was .00096, identical to Sample 1;

however, the incremental stair like nature of Sample 3, displayed in Table 13, is fundamentally different than that of Sample 1 provided in Table 12. Activity within Sample 3 surrounds the development of prototype drawings for the grenade. Such drawings are typically generated to facilitate the construction of a prototype device for proofing operating principles. For this inventive experience, the prototype designs served to communicate with potential licensees, as well as maintaining my focus on the producibility of the small, but relatively complex, grenade. Analysis of the mere 496 words contained within Sample 3's transcript produced 17 labels that collectively occurred 38 times (Appendix 4-M). The most frequent label, being assigned a total of 6 times, was Emotion, which is indicative of the stress associated with reducing a complex functional drawing package into a simplified prototype configuration. A feeling of lost effort typically surrounds the process of simplifying the embodiment of intellectual complexity with cost and producibility trade-offs. Not surprisingly, concern with Manipulation of the computer (5 ea.) and Producibility (4 ea.) were quickly followed by

Inattention (3 ea.), difficulties with Concentration (3 ea.), Uncertainty (2 ea.), Time (2 ea.), and Fatigue (2 ea.). The 17 labels of Sample 3 were categorized into seven areas, including Intellectual (13 ea.), Emotional (7 ea.), Automation (6 ea.), Producability (4 ea.), Appearance (3 ea.), Environmental (3 ea.), and Physical (2 ea.).

Sample 4

Sample 4 was a near flat segment preceding a significant increase in changed activity. It encompasses the timeframe between 0645 and 0811, and project time of 0738 to 0811 on Saturday, 10 June. Total project time was 88 minutes and resulted in 3 DTGs, 3 drawing pages, and 31 reference areas. The slope of Sample 4 is .000047, which is lowest in total value as provided in Table 17. It was a time of frustration, and uncertainty. The drawing, specifically dimensioning, activity had pushed the computer to the limits of its capability, and the emotional/intellectual conflict between the original design and the prototype “cheapening” remained. The near flat slope of the curve, was indicative of the enthusiasm involved. Analysis of the 192 transcribed words resulted in 10 labels that collectively occurred 17 times (Appendix 4-M). Emotion (5 ea.), Manipulation of the Computer (4 ea.), and Discontinuity (2 ea.), topped the label list. As might be expected, only three categories emerged, including Intellectual (7 ea.), Emotional (6 ea.), and Automation (4 ea.).

Sample 5

Sample 5, taken between the hours of 1312 and 2156 on 20 June, represents minor activity preceding a marked increase in productivity. It is the first sample from Phase 3.

The total project time for the sample was 152 minutes and resulted in 5 DTGs, 6 drawing pages, and 29 reference areas. The slope of the sample was .00079, placing it 7th of the ten samples in total changed material (Table 17). Within the sample, a total of eleven Changes were made to seven parts, and four Additions to an additional three parts. The primary Power Spring received the majority of the activity, with four separate changes and one addition. This sample may best be described as a time when I prepared various drawing parts for submission to the PTO. I was still avoiding those aspects deemed difficult (part naming and numbering), so activity during this period was a function of doing "something" constructive, rather than doing "nothing." It was a stressful time. The proverbial rubber was hitting the road, and I had to cause the computer to produce PTO quality drawings at the printer, while simultaneously preparing to deal with the PTO itself. The Patent Office bureaucracy is an arbitrary one, perpetuated through vague, and seemingly contradictory, regulation. Coding of the 546 word transcript provided 15 labels, with Emotion (13 ea.), Manipulation (10 ea.), and Focus (4 ea.), providing 56% of the 48 total labels. A total of five categories were identified, including Emotional (17 ea.), Automation (13 ea.), Intellectual (10 ea.), Environmental (4 ea.), and Physical (3 ea.).

Sample 6

Sample 6, the second sample from Phase 3, includes 0650 - 1334hrs. on Wednesday, 21 June. While the total slope for the sample is .000072, the number is misleading, since the activity was divided and concentrated at the beginning and end of

the sample. Total time for Sample 6 was 180 minutes, which resulted in 4 DTGs, 5 drawing pages, and 23 reference areas. The period covered by this sample might best be defined as flat. Most of the perceived design challenges had been met, and what remained was the more mundane redraw and check for PTO standards. The 331 word transcript resulted in 9 labels, with Environment, Focus and Manipulation appearing 4 times each, and Concentration, Emotion, and Time occurring 3 times each. Five categories were generated to combine the 24 labels. These included Intellectual (9 ea.), Environment (7 ea.), Automation (4 ea.), Emotional (3 ea.), and Appearance (1 ea.). These categories are indicative of the experience during this timeframe. Although a certain amount of intellectualism was involved, the environment, computer interface and the constant push of time were interwoven into a frustrating period of existence. Wanting to ignore the PTO numbering and naming requirement, and having extracted the maximum pleasure from the development process, the future held only drudgery and stress.

Sample 7

Sample 7 started at 1924 hrs on 21 June and ended at 1253 hrs on 23 June 95. It is the final sample from Phase 3, and provides a small knee in the curve between 1924 and 2150 on Wed., 21 June. A majority of the changes (18 ea.) that occurred during this period were generated as previously developed designs that were implemented across the drawing package. By the end of this sample, I had resigned myself to preparing (vice the previous fighting/avoiding) the PTO package. The total of 229 minutes from this sample

resulted in 5 DTGs, 8 drawing pages, and 27 reference areas. The slope of .000079 was sixth in total productivity. A total of 19 labels were assigned from the 888 word transcript of the event. Consistent with other samples, Emotion, with 11 of the 61 total labels topped the list. Manipulation, Analysis, and the Environment contributed eight, five and five respectively. Ignoring frequency, additional labels that were generated with this sample included Pride, Fatigue, Determination, and Discontinuity. The derived categories summarize the changing experience with Intellectual (20 ea.), Emotional (16 ea.), Environment (9 ea.), Automation(8 ea.), and Bureaucracy (5 ea.) rounding out the top five.

Sample 8

Sample 8, the first sample of Phase 5, represents a transition back into the experience of preparation for Patent Application on 01 Aug. It is a time requiring discipline, both mental and physical, to complete the task. The break has had advantages and disadvantages. While the pressures built-up during the first three phases are gone, the uncertainty of dealing with the PTO remains. The experience tended to be all encompassing initially, and the break generated a need to climb back into the project. This was done during the 173 total minutes associated with Sample 8. The sample resulted in only 3 DTGs, 21 drawing pages, and 54 reference areas. As will be evidenced by the coding, this was a superficial time that would ultimately result in resubmersion in the project. Twelve labels were extracted from the transcripts, including Emotion (10 ea.); Avoidance (8 ea.); Uncertainty (7 ea.); Time (5ea.); Interruption, Focus and

Verbalization with three each; and rounded out by Fatigue, Manipulation, Planning, Escapism, and Privacy. What escaped the transcript was the tone and inflection of the verbal recording. The combination of apprehension and anger produced a stress-laden time. Apprehension stemmed from the long delay, the short time remaining to complete, and the amount of work remaining to be done, including the Patent Application. Anger was directed at the PTO and the arbitrary ambiguity they represent.

Sample 9

Sample 9, on 22-23 July, provides a significant increase in activity. The 398 minutes associated with this timeframe provided 15 DTGs, 16 drawing pages, and 37 reference areas. With a slope of .000103, this sample is one of the most productive. The avoidance of the PTO numbering requirements is over, and although it might not be fun, the mission is being accomplished. It is interesting to note the primary label generated from this 1250 word transcript was Emotion, with 19 occurrences, followed by Computer (14 ea.), and Momentum (11 ea.). This is indicative of the effort necessary to name and number every part, as well as my fear of breaking stride and not being able to get it back. Momentum, or the "Big M" has been perceived as critical to maintaining progress during distasteful tasks. The top three categories, including Emotional (32 ea.), Intellectual (24 ea.), and Automation (18 ea.), summarize the emotional commitment to accomplish the mission, the intellectual commitment to prevent mistakes, and the automation aspect which reflects the computers importance in this effort. It should be noted the technical drawing software I was using was extremely effective at producing drawings; however, it

was cumbersome when attempting to enter text onto a drawing. Since all numbers are considered text, the program continually had to shift between text and the connecting lines between number and object.

Sample 10

Sample number 10, occurs within the final few days of the project and provides for a rapidly increasing then gradually decreasing rate of change. Sample 10 is the timeframe between 1424 on Monday 24 July, and 0924 Wed., 26 July. The project time for the sample was 385 minutes and resulted in 6 DTGs, 7 drawing pages, and 18 reference areas. Activity during this period was divided between final preparation of the drawings and focus on the Patent Application. The only thing I wanted to do less than name and number the drawings was to work on the Application. With the fight against numbering pretty much lost, could the application be far behind? One of the three most productive times sampled, the changed parts were distributed between some last minute changes to the interlock handles and completion of the positioning and numbering of items for the PTO. Time was a factor in every decision. By the end of this sample, I was less than five days from my scheduled application date. Of the twenty labels assigned to this sample, Emotion was the most frequent (15 ea.), followed by Manipulation of the computer (9ea.), Momentum (7 ea.), Design (7 ea.), and Safety (6 ea.). Rounding out the top ten, and indicative of the work and stress associated with this sample, were Computer, Function and Time with five each, and Interruption and Fatigue with four and three respectively. Eight categories emerged from the labels. They included Emotion (25 ea.),

Automation (14 ea.), Environment (11 ea.), Operation (11 ea.), Appearance (8 ea.), Intellectual (5 ea.), Physical (4 ea.), and Bureaucracy (2 ea.).

Ordered Sample Summary

An analysis of the selected samples was performed in an attempt to understand relationships that might exist within their individual and collective context. A comparison of labels and categories was made when the samples were ordered numerically by slope, and again, when chronologically sequential. While some similarities were noticed when ordered by slope, few trends could be identified that would provide insight into the process from the perspective of increasing activity. In eight out of ten cases, emotion was the most frequently identified label; however, when slope per reference area was considered (Table 17), Sample 1 most frequently labeled Function (15 ea.), which would be inconsistent with Samples 2 and 9 where Emotion topped the list (19 ea.).

A review of the samples in order of their occupance within the experience provides considerably more insight into the mental processes that occurred. Sample 1 highlighted the Function of the device (15 ea.), the Design (7 ea.), Manipulation of the computer, perhaps the learning curve coming into play (7 ea.), and Emotion (5 ea.). Further coding would have indicated this emotion to be much more positive than some of the subsequent emotional activity. By Sample 2, Emotion had bubbled to the forefront (19 ea.), closely followed by Function (18 ea.), and Design (10 ea.).

These first two samples, representing Phase 1, contained the excitement of the

hunt. Challenge was defined as identifying those design aspects that would ultimately end in success. In both cases, Fatigue was at the bottom of the label listings. Functionality (operability) and design (appearance) were foremost in thought and fueled by excitement (Emotion).

By Sample 3, Emotion still topped the list; however, when compared to the previous sample, Manipulation of the computer had replaced functionality and Producability of the product was replacing enthusiasm with the harsh reality of the supply and demand world. Sample 4 reflects the continued change within Phase 2. Emotion still topped the list; however, Manipulation, Discontinuity and the Computer itself were also tied for the second position. The type and positive quality of the emotion had forever shifted to a reality based drudgery that would endure for the remainder of the experience. The positive emotions would only sporadically reappear during times of additional development, reminiscent of the proverbial “hunt” described in Samples 1 & 2.

Sample 5, the first of Phase 3, continued the trend of labeling Emotion most frequently. During the times of positive design development and constructive progress, the emotion might be considered a positive one, but the stark reality introduced by Phase 2 would always remain. Manipulation held a firm grip on second place for this sample, and is indicative of the shift from the joyful design process to the drudgery of conforming to the commonly accepted drawing standards, and ultimately to the “fuzzy” PTO requirements. By Sample 6, the polish was off the apple, and though Emotion continued as the most frequent label, Focus and Manipulation had moved into a tie for second place.

Manipulation of the computer had become so boring as to cause concern over my ability to maintain the disciplined approach necessary to accomplishing the mission. Sample 7, the final one from Phase 3, was a time when my perception of the project was one of near completion. With the end in sight, I could get through almost anything. Interestingly enough, Analysis of the device moved into third place among labels. This is indicative of a final mental check of the configuration and properties, prior to calling it quits. The full ramification of this Analysis would not be fully understood until Sample 10.

Sample 8 was a return to the project after several weeks of inactivity. There was an initial learning curve, as I refamiliarized myself with the project, accompanied by the constant pressure of time. I had scheduled my Application date to be 01 Aug. and nothing would stand in the way! The Emotion of Sample 8 was closely followed by Avoidance and Uncertainty and Time as the next labels on the list. The time had come to conform to the PTO requirements for naming and numbering of parts, and it was something that I had talked about and dreaded from the first line on the first page. On more occasions than I care to count, the transcripts reflect my assertion for the need to at least name the parts. It would have given me a common nomenclature by which to refer to specific parts. I could not bring myself to do it. It made, and still makes no sense. Not wanting to number the parts is in some ways understandable. To do so takes considerable time and energy, and no matter how hard I try to get it correct, invariably there are inconsistencies between parts across multiple drawings. The process by which those are checked, caught, and corrected could best be understated as painful. However,

establishing part names carries none of the logistical baggage associated with numbering. Naming is the simple process of determining and learning various labels. The payback would have been considerable, and I realized that on numerous occasions; however, I could not bring myself to do it. Such behavior was, and is, not strictly rational.

Sample 9 and 10 are on the glidepath to completion. Both lead with Emotion; however, between the two samples, glimmer of positive activity occurred that might be traced back to the analysis that occurred in Sample 7, at the end of Phase 3. It was during that evaluation of the functionality of the grenade that the seeds were planted that resulted in a significant change to the loading door mechanism of the device. Prior to Sample 10, the loading door had been ignored beyond establishing the rather complicated projection drawing showing its movement and inter-relationship with Part Number 64 the lock-out handle. [Note how I just avoided finding within the memory banks and applying the correct nomenclature for P/N 64!?] I was proud of this drawing, the first I had done which demonstrated the power of the computer assisted drawing process. In retrospect, it was partially due to this fancy drawing, and partially because it was a complex problem that I had not been able to think through, that I had accepted the loading door as something that I hoped the PTO would consider adequate. After Phase 4 and Sample 9, I came to believe the design of the loading door to be inadequate to assure the operational safety of the device. If there was a pure design effort during the entire project, the loading door was probably it. As the drawings indicate, I knew something had to be done, but did not have a clue as to the ultimate outcome of the design. I tried several paths, a couple of

which should never have been tried. This was a third type of emotional energy. The first, excitement of unconstrained design; the second, drudgery of the execution; and this third, the bridled enthusiasm of the constrained design environment. It was a time when the flood of potential solutions was left unchecked long enough for me to waste considerable time developing a design that could not have existed within the operational parameters of the grenade. When I started, I knew errors could happen, yet still felt the need to charge off. The result was a better understanding of the problem and ultimately a solution; however, this period of time was perhaps simultaneously the most and least structured within the entire experience. Somehow I felt that mistakes might be the price to be paid for a maximized solution. Interestingly, the thought processes used during development of the impossible design ratified many of the previously accepted aspects of the overall configuration, and in some way increased the purity of the final loading door operation. If there was a part of this entire experience that seemed illogical from a design perspective, the refinement of the loading door would be it. My ultimate success provided the enthusiasm and momentum necessary to finalize the project on time.

Sample 10 provided an interesting mix of pride and apprehension. Time was the only constant, and I wasn't very good at judging how long writing all those words in the Patent Application would take. Changes to the drawings were largely cosmetic, although fear of a mistake loomed like a cloud. Emotion, Manipulation, Momentum, and Design were joined by Safety as labels describing Sample 10. One might speculate the Analysis of Sample 7 had matured into Safety by Sample 10. The task was finished and

Concentration and Focus had all but dropped off the Label list.

In the conclusion of the Verbal Data analysis, it is obvious that Emotion, perhaps all kinds of emotion, played a considerable part in this inventive experience. Analysis of the coding provides insight into the chronological thought process; however, was of little apparent value when attempting to understand the samples when ordered by activity or time slopes.

Written Data

Written data comprised of calculations and drawing notes were individually annotated by DTG, and given the non-linear iterative nature of their properties, have been compiled as closely as possible to chronological order. Examples of this material are included as Appendix 4-N. Although such notes provide valuable confirmation of the thoughts and actions recorded verbally and via the developmental drawings, I could extract little additional information from this format. It wasn't my nature to mark up a drawing and not comment about it verbally. Such comments were collected and are available elsewhere within the data. Of the instances I checked, the written comments were simply an extension of the verbal data. No additional effort was expended on their analysis.

Reverse Analysis

A considerable effort has been expended in an attempt to understand the inventive experience from both qualitative and quasi-quantitative perspectives. In a final attempt to dislodge any remaining insight from this experience, I proceeded to reverse analyze

specific drawing threads. This was accomplished through a process of reviewing changed activity on a series of drawings, and beginning with the last drawing reference area, recording the specific thoughts and reasons that precipitated each change decision. The results of this analysis are included in Appendix 4-O.

Additional Facets of the Experience Process

Phenomonological data collection is a challenging process. The desire to do it well, to collect adequate and appropriate data, must continually be weighed against its distortion of the very experience under study. For me, data collection was an opportunity I am not anxious to repeat. Is it possible to capture 100% of the "experience"? Definitely not! Did I capture 70%? 80%? 90%? I am unsure of my answer. I am willing to say that I captured as much of the experience as was possible for me, within the context of my physical, intellectual, and emotional parameters. Significant experience and training as an "tester" for the DoD provided invaluable discipline for recognizing, collecting, and ultimately analyzing the data that were collected. The discipline of Phenomenological inquiry did sensitize me toward occurrences that had previously gone unnoticed. It also created some serious physical, intellectual, and emotional burdens upon the individual under study. A single example may suffice. Early one Saturday morning, I awoke and began thinking about the project. It was not the first time, nor would it be the last, but on this occurrence, for whatever reason, I opted not to make an effort to capture the moment. The ensuing guilt associated with this decision was significant. I irrationally found myself wondering if I had done something that

would unreconcilably undermine the project, simultaneously failing in my duty as a researcher, failing my committee, and failing in my contribution to society's collective understanding of the process of invention, a failure I had worked so hard to prevent. Guilt fueled my memory of that Saturday morning as I started to record it later in the day, when in disgust, I recorded the item and ceremoniously threw it away. Whhhhew!

Interaction with Self

For me, invention is both exciting and laborious. It is time of great learning, and a time to be with, and better understand my thought and emotional processes. As strange as it may seem to some, it is a time when I talk to myself almost constantly, while only sometimes enjoying the company. This previously unrealized communication appears to have an impact on when and how I work through the inventive process. Since our society tends to frown upon people walking around talking to themselves, there has been a natural limitation on where and when I have worked. Even at home, the data collection and occasionally my work itself would stop when family members entered the room. Some of this may be fear of them only half listening and taking something out of context, and the remainder from the disruption to concentration. Interwoven with this personal communication is the computer. As previously discussed, the availability of the computer appeared to determine when and where I would work. I could only speculate on whether these limiters are cumulative.

Interaction with Others

Within the data, there are several references to traveling to the mall, either to

shop, or while waiting for my family. While these expeditions were perceived to contribute to my motivation and energy level, there were few occasions when I could perform meaningful work in the presence of others. Perhaps it was distraction, perhaps there is an aspect of the process that I perceive to be a private one, and unwilling to subject the process to scrutiny of the general public.

Invention as a Learning Experience

One of the implicate facets of this experience is learning. For this undertaking, the most obvious learning process was the introduction and successful use of the computer for drawing production. But the learning was much more insidious. As I look back, much of the activity and most of the processes could be construed as learning. In a global sense, beyond the generation and manipulation of parts, much of the combining, decision making, and rejection are all part of a learning process. One has to learn what will and what will not be acceptable for any given situation. As the constraints increased, the learning became more difficult, and of course, more time consuming. The question would be if the latter was more sophisticated learning, or simply more difficult to accomplish. If one were to accept any of this as a premise, one would find that with the application of the previously articulated self-communication, that this inventive experience was an exercise in teaching myself what I needed to know about the constructs of this device to be successful.

What could be gained by perceiving invention as a “learning” rather than an “creative” undertaking. First, it would focus and place the responsibility of determining

what needed to be understood before one could proceed, squarely upon the shoulders of the inventor. This might seem like a small thing, but in a commercial environment, it would suggest that the role of the supervisor might be formalized around that of a learning manager, rather than a disciplinarian.

Second, it would suggest that a solution was possible. Few problems are unsolvable, the remainder are simply perspective and application of existing knowledge. A learner has a responsibility to determine what he needs to know to proceed. This too, is a shift in the locus of responsibility.

Time as Both Constant and Variable

This chapter wouldn't be finished without a brief discussion of time, and more specifically, my perceptions of time throughout this experience. Although we are taught to think of time as a constant, there were numerous occasions when time was acting like anything but a fixed entity. The best evidence of this may be the large variations in durations between DTGs (Table 2). I had every intention of saving, thus creating DTGs, at regular intervals. As can be seen by the variations, that typically didn't happen. Admittedly, many of the short "saves" were the result of a variety of motivations, including just trying to do "something." The longer "saves," are indicative of something entirely different. As every computer user knows, it is irrational not to save frequently, to defend against a variety of environmental interventions. Some of my longer iterations of DTGs flies in the face of that logic. I did not do something as potentially catastrophic as consciously ignoring a save opportunity. What appeared to be happening, was a

transition to a level of focus or concentration that disassociated me from a sense of time or external stimuli. The transcripts are sprinkled with references to lost time. On the opposite ends of the spectrum, is the difficulty I experienced trying to maintain concentration and focus on the more mundane aspects of the experience. These instances are similar to what everyone experiences as time “dragging” when we cease having fun. I don't mean to suggest that the two are opposites. For me, in this context, they didn't appear to be. One is hypersensitivity to reality, where every second seems like an eternity, the other, a shift in consciousness that transcended reality, resulting in the computer, and more specifically the constantly refreshed computer screen taking up a position of “oneness” with the operator. This happens to the exclusion of all external stimuli. My attempts to graphically display this state fell victim to the limitation of two dimensions to depict a multidimensioned event.

The PTO

As a longtime member of a similar Federal bureaucracy, I probably have more of an appreciation of the PTO's environment, limitations, and constraints than most others attempting to acquire a U.S. Patent. As an inventor, my perspective on, and relationship with the PTO might best be described as love/hate. The impression I have is an organization that looms on every inventor's horizon, simultaneously beautiful and seemingly insurmountable. Attempts to communicate are made through a mailroom that receives and handles literally tens of thousands of items a day. Typically an inventor's hopes, fears, pride, and self-respect are sealed in an envelope that is thrown at the PTO

and....and....the response is not forthcoming. As an example, my application was received by the PTO on 01 Aug. 95. Confirmation (their return of a self-addressed stamped postcard acknowledging receipt of the laundry list of items that must be included) was not received for 30 days. Such a time lag is not something that calms the typical inventor; however, it does set the tone for things to come. With luck, the application will be assigned a classification, and authorization to file foreign patent applications will be received within another two weeks. Then the waiting game begins. For me, it typically been 18 to 24 months later, before the PTO will respond with the first Office Action (OA). OA is the PTO vernacular for activity on your application. Unless the application is rejected outright, one or more claims will be denied, based upon any one of a number of less than objective criteria. Interpretation of prior art, interpretation of usefulness, or worse yet, nonobviousness are always a possibility. To add insult to injury, the PTO will typically “administratively shorten” the 90 day response period to a mere 30 days. It’s O.K. for the customer to wait, but not them?!?! Several years worth of negotiation may lay ahead. Unfortunately, most of the rebuttals can cost money. Big Money! Appeals for reconsideration, for mistakes, for almost anything requires an influx of cash. The money is not the PTO’s fault, Congress makes most of those decisions as part of public policy; however, the checks always say PTO, and the distinction is frequently lost. If, and when, the inventor perseveres, the issuance will be scheduled, and all the simultaneous frustration that the inventor has been enduring with the PTO Drawing office (the arbitrariness and subjectivity of the examining section pales in

comparison to the ever shifting interpretations of the “Rules” for Patent Draftsmen the patent will be sent to the Government Printing Office for publication. Several hundred dollars for issue fees, and \$3 per copy of the Patent is all that is necessary. How can an inventor not love the PTO??

Chapter Five: Implications and Significance Of the Study

I believe a discussion on the implications and significance of a study as personal as this must begin within the context of the undertaking. My context included the product of the experience, specifically the Patent Application, complete with academic and economic implications; and the process of the experience, or the time devoted to the inventive episode as defined by this research. Also included must be the hundreds of hours consumed transcribing, printing, understanding, coding, analyzing and articulating the data produced during the sixty-two days. Finally, the context must not neglect the inevitable trade-offs that one makes to facilitate the completion of such a task.

Questions may arise about the usefulness of these data when applied to other inventors. It was not my intent to infer generalizability between my context, both internal and external, and any other inventor. This was, and remains, a singular experience designed to better understand one unique inventor performing in a quasi-unconstrained environment. These findings should be of value, however, to those interested in better understanding the “lived world” of an inventor.

I also hope the data collection and analysis techniques that emerged from this experience will be of value to others. They are far from mature, by any definition, but I believe they constitute a springboard for capturing and understanding this and similar types of behavior.

An Appreciation for the Derived Experience

As this process approached its natural conclusion, the question I have been asked most frequently is "What did you learn?" For several weeks, the question haunted me. I didn't have what I considered a good answer. Indeed, aside from the obvious, what was the product of this inventive experience?

I now believe the most significant breakthrough provided by this research was a new understanding of the mechanisms by which I perceive and manipulate concepts that ultimately mature into patent applications. The fact I was a proficient visualizer came as no surprise; it had always been my "lived" experience. However, the subtle shift between visualizing existing objects (those memories that had been previously recorded and stored), and conceptual objects (those that had yet to exist) had heretofore escaped me.

I now understand the perceptual mechanism to be a derivation, or perhaps a subset of my visualizing process. Less complex than a full-blown recalled image with its shapes, colors, lighting, shading, and mass, they contain rudimentary form and function without the associated colors and mass. These "diagrams" are used while manipulating images of one or more known objects for purposes of combining or refining into a viable product. Though closely resembling the drawings with which I have communicated my thoughts for years, these diagrams exist in a visually conceptual context that facilitates the high speed manipulation.

Once this diagrammatic manipulation has resulted in a potential solution, the image is

matured with the addition of color, shading, mass, and surface texture, all within an accurate three-dimensional construct.

If asked why my mind appears to behave in this manner, I would use the computer as a metaphor, and suggest it to be a function of processing capacity and time. The speed at which these diagrams are manipulated could not be maintained if, during the initial search, accurate and complete visualization of the components was attempted. As the number of global manipulations decreases, the content and complexity of the images increase. With this refinement, comes the ability to verify the selected components mentally and cause the device to function mechanically.

A second significant product of this research is my adoption of the computer as a physical and intellectual extension, some might even say a partner, in the inventive experience. The previously discussed mental manipulations appear to have a practical limit to their size, composition, and complexity. Using the computer as an extension of the intellectual loop, I am able to “download” large portions of the diagrammatic material at various stages of manipulation. Storing these images on the computer screen allows the manipulation to shift from a purely internal intellectual exercise, to a quasi-external process with my mind being assisted in the storage and manipulation by my physical manipulation of the computer and the resultant visual image on the computer screen.

My perception of these events includes the possibility of the computer acting as an external storage and manipulation device in conjunction with real-time intellectual

processes. Although outside the scope of this research, I find it possible to achieve a level of apparent concentration providing a perceived “one-ness” with the computer, to the exclusion of external consciousness and the perception of time.

I believe the newfound understanding of my visualization process and the incorporation of the computer into the inventive experience are significant products of the research. The identification of diagrammatic visualization processes explains why I perceive my developmental drawings to be true reflections of first order mental processes.

Adoption of a computer as a partner in the inventive experience may also shed light onto what I perceive to be an increasing complexity in my most recent patent applications (including ones generated subsequently to this research).

To continue with some of what might seem the more obvious products of this research, I now have a renewed appreciation for the role of communications within the inventive experience. Perhaps the difference between inventive and noninventive communication surrounds the complexity of the content. Having always taken for granted is the use of drawing, during the inventive experience, I never gave drawing proper consideration. Drawing is a language. Like other languages, it has rules and procedures that facilitate a universal understanding of the content. Also like language, there are shortcuts, or slang, that provide emphasis or save time. I have always been enamored with engineering drawings, and requested a drawing board, T-square, and rudimentary instruments as a birthday present when I was in the seventh grade. My

parents were more than a little puzzled, but consented.

Closely tied to the visual impact of drawing are the emotional aspects of the inventive act. To summarize what was discussed in detail in Chapter 4, the complexity, variety, and interrelationships of emotions are staggering. Questions such as: can it be done; will it work; is it safe; will it be accepted in the marketplace; represent only the tip of the iceberg. This apprehension, periodically turned inward, resulted in significant anger. I was frequently at odds with the concept, the design, my progress, the PTO, the calendar, and the total time being consumed. Also interwoven were facets of escapism, avoidance, guilt, and joy. Existing as an apparent contradiction, I would suggest enjoyment to be an over-arching context within which the inventive experience exists. Finally, my perception of the inventive act is one of tolerable stimulation. Inventive stimulation is one of the few experiences that never reaches an overload status. This may be a critical insight, given an existence of unbounded excess. Especially enjoyable is the anticipation of discovering what lies around each subsequent corner, and at the end of each perplexing question. As might be expected, the emotion tends to become less constructive as the learning experience subsides. It occasionally becomes dysfunctional, or perhaps more accurately, counterproductive when learning, expansion, evolution, and (even) iteration ceases, and redundancy commences.

Beyond these results lies an area ripe for anecdotal speculation, which I feel

should be part of the record. The first, is my decreasing tolerance for the constant, sometimes incapacitating, surge of overlapping concepts and ideas continually bombarding my existence. Occasionally, I find myself wishing it would just stop. Different from the previous cascade of emotions, these are intellectual assaults, with little or no physical or emotional involvement. Two environments appear to moderate this phenomenon. The first is driving an automobile, the second, sitting in front of a CRT. Although I have yet to understand why, I might speculate it to be a function of the visual input while driving, and the constant screen refreshment of the computer.

Indeed, the inventive act appears to be one limited to tolerable stimulation. One might speculate upon my propensity for invention being the result of this control, or if somehow, during the development of my creativity skills, I learned to control the flood of ideas constructively. One scenario might suggest the flood of ideas to be appropriate in the inventive environment, and as a result, less stressful and less noticeable. In any case, the inventive act appears to create a focus which provides momentary freedom from the ever present discontinuity in thought and existence.

Somehow interrelated with the aforementioned is a perceived phenomenon associated with the generation a drawing package. Much of the work is mundane. The processes of refining a complex part to accepted drawing standards can take several hours. During these periods, I perceive a “sorting and ordering” activity occurring within my intellectual processes. When complete, I often feel as refreshed as the morning

after a restful night's sleep. I would liken this experience to the removal of disorder that results in renewed capacity from which new activity is free to occur.

Extrinsically, the largest single motivator is the PTO. Almost everything they do, and many things they don't do, has direct impact upon the Independent Inventor's environment. Less noticeable external motivators include the near constant inquiries of friends, and family members, about progress, viability, and time lines.

I perceive intrinsic motivation as a much more complicated concept. At some level it includes a desire for success and wealth; need for respect from family and friends; perceptions of usefulness; and sometimes occupational or public acceptance. Other factors include the need to "make a mark"; provide a springboard for children; leave a legacy; and create concepts and items that will exist in virtual perpetuity as part of the body of Patent literature. Lastly, invention fills the ambiguous void of "what to do next," somehow interwoven with an inability to rest, and relax.

Perhaps the final eye opener of this process was my new found understanding of my varying tolerance for uncertainty. If asked, I would have asserted a high tolerance for ambiguity and uncertainty; however, an examination of the data would suggest otherwise. There are clear indications that my tolerance is contextually selective. By example, my ability to withstand the ambiguity associated with the variances in PTO personnel is near zero, while my willingness to tolerate the lack of viable solutions for a critical component of my invention was near limitless. Closer to home, my tolerance when waiting for a

visual idea is significant, while little or no patience is associated with a verbal memory search.

In summary, the immediate listing of "what I learned" is all but complete. The long term ramifications of this research must occur in the out-years. In retrospect, my difficulty realizing the product of this undertaking may be directly related to the constructs within which it occurred. By example, suppose the reader was asked to remain phenomenologically cognizant of tonight's drive home, a drive that may have been made dozens of times previously. At the completion of the drive, the "what did you learn" question was administered. I suspect a number of the more obvious findings would initially be excluded due to a lack of appreciation of their significance. The fact that you maneuvered the car toward your home, and into the garage, would in all likelihood be minimized. But actually, many of the steps in accomplishing the driving mission were critical. Being able to back out of the current parking space; knowing the rules of the road; understanding and controlling the physical/mechanical interface that resulted in stopping for a red light before impacting the car ahead; and starting with the light's change to green before angering the drivers behind you. All of these things are critical to driving, and like invention, many may have never been captured in the driving literature. They are, by definition, the context of driving (or invention) that everyone is expected to know and execute; however their individual importance with respect to the total driving experience may never have been established. Since everyone eventually learns "how,"

within some broad parameters, then research to determine the optimum application and mix of skills has never been accomplished. The question of potential payback has always fallen victim to the breadth and universality of the occurrence.

So it may be with invention. Many of the specifics identified and entered into the record from my research may initially seem obvious to other inventors. The difference between driving and invention is one of total distribution. If we were all inventing, then some of my findings might be considered less important. Since we all don't invent, I believe that these findings can further our societal sensitivity to even the more obvious constructs of the inventive act.

As with all phenomenological research, some findings are unique to the subject, while others may extend into the population and should become subject of future study. Aspects of the apparent visualization skills have been mentioned in the literature, and will be addressed in the following paragraphs. Communicative skills, specifically comfort with the drawn page, the role of emotions in the inventive process, and the myriad of motivations may be found commonly across inventors and need to be reinforced through future research. I will now return to the literature and examine the similarities, differences, and advancements contributed by this research.

Relationship of this Undertaking to Previous Research

At the outset, my research used the existing research as a starting point for creating a framework within which I could proceed. In retrospect, having completed the

data collection and analysis, it is now obvious that the existing literature originates from what might be perceived as a different "stratum" of intellectual processes. Although there was no intent to replicate any of the existing material, I anticipated more relevance to the previous literature material than was eventually uncovered.

Previous research largely consisted of researchers studying inventors, researchers attempting to compare inventors with non-inventors, and researchers attempting to understand how inventors thought and acted. In all cases, these efforts were attempts to acquire insight from physically outside the process. My process stood inside the inventive act and looked out, while simultaneously inviting others in. This was not an easy undertaking, and not a process I would recommend to the weak of heart or personality.

My perspective on the existing invention literature has shifted as a result of this research. For the first time, I have begun to internalize that which I had been previously echoing, and come to understand the existing literature as speculative, rather than informative. I realize these may be perceived as harsh words; however, the literatures' externality to the lived experience, may necessarily limit it to an examination of identifiable heuristics and resultant artifacts.

Returning to my metaphor of perspective, the existing literature stood outside the process and look inward, and my own perspective from within the inventive act, was looking outward. As might be expected, the results, conclusions, and even speculations

from my research are considerably different from the existing literature. I had the luxury of not only observing, but experiencing, the inventive act. As might be expected, my results and perceptions vary considerably from those of previous researchers.

In an attempt to answer the question of my contribution to the invention literature, I hope the answer includes the thoughts, activities, emotions, expectations, frustrations, motivations, joy, and anger associated with my inventive act. I didn't compare myself to another (competing) inventor in some race to conclusion, or attempt to extract linkages between specific thoughts and actions that might be perceived as more and less important. What I did do was allow the reader into my inventive processes, first through the spoken and written word, then through the establishment and implementation of the analysis of my developmental drawings. Although history seldom provides consistent developmental drawings from which researchers can interpolate thoughts and activities, the methods for cataloging, analyzing, and understanding drawn material developed during this research provide mechanisms by which others can structure future research to take full advantage of these techniques.

Comparisons between the creativity and problem solving literature were nowhere nearly as significant. The reason may lie in what I believe to be our relatively immature understanding of both processes. Granted, every human being solves problems, and from time to time can be perceived as creative; however, having once experienced a phenomenon does not qualify as the basis of a generalizable theory of human thought

processes. As might be expected, I believe the path to realistic understanding of these complex mental processes lies beyond hundreds of future self-study projects. Then, and only then, might we begin an analysis that will provide insight into the ever changing intellectual solution mechanisms.

Implications for Diagrammatic Visualizing Inventors

The implications of this research for other inventors possessing diagrammatic visualization characteristics may be significant. Apart from the typical reactions associated with better understanding oneself, existing inventors with similar mental manipulations may not realize the potential impacts/benefits that might be derived by using the computer as an extension of their inherent capacity. Additionally, the adoption and use of the nonverbal analysis techniques might lead each inventor to understand the characteristics associated with his or her invention experience better. Although I remain unconvinced that any two invention processes are identical, they may possess similarities that once realized, could provide physical and emotional efficiencies that could prove beneficial.

Finally, a realization of the number, intensity and variance of the emotional experience of invention might become clear. Specifically, the roles of anger, joy, frustration, and their situational tolerance of uncertainty might facilitate the creation and maintenance of a more productive inventive experience.

Implications for Non-Visualizing Inventors

Although less profound than for diagrammatic inventors, the implications for non-visualizing inventors might be significant. Acquisition of an appreciation for one's intellectual processes and physical responses provides a path for positive behavior modification and future growth. Using the broad cross-section of material resulting from the phenomenological framework of this research as a construct for understanding their own thoughts and actions, other inventors might become sensitized to experiences that could potentially improve their own processes. Indeed, the perception of, and conscious reaction to, the lived experience might become the basis for future growth and maturation as inventors.

Adoption of the nonverbal data collection and analysis procedures introduced by this research might provide the non-visualizing inventor with insights into activities that are out of sync with their verbal encoding processes. With non-verbal analysis may come a renewed appreciation of the visual medium for formulating and communicating new inventive developments.

Implications for Potential Inventors

Implications of this research for those contemplating invention as a future pursuit might be either positive or negative. At first glance, this research could easily be perceived as legitimate reason for avoidance. Invention can be a complex and time-

consuming undertaking, requiring significant personal, professional, and financial commitment. Invention can also be incredible fun. For those with perceptions of the latter, this research might be considered a partial guide for successfully understanding and completing the activity.

Contained herein, which was unavailable when I began on the inventive path many years ago, is insight into the academic literature on invention, problem solving, and creativity, combined with a step by step description of the process embodied by this experience. Although the initial spark, and the tenacity must be provided by the student, an understanding of one person's physical, intellectual and emotional experiences are included on these pages.

I would not recommend that the neophyte attempt to engage in collection and analysis of nonverbal data, such activity will seem more practical over time. I would suggest that both the verbal and nonverbal portions of this research be studied in conjunction with the acquisition of minimum drawing skills necessary to adequately articulate one's invention to the community at large. Several books listed within my bibliography might be helpful in gaining additional insight into the rules, regulations, and culture of the inventive environment as defined by the U.S. PTO.

Implications for Adult Educators

Attempts to summarize potential implications of this research for Adult Educators will inevitably necessitate the interpretation of the inventive experience, and require the

reader's indulgence in my ability to articulate those aspects of the process that remained implicit throughout the time frame.

The most obvious impact of this research on the Adult Education community is the identification of what I will continue to describe as diagrammatic visualizers (DV). This subgroup of individuals poses additional challenges over and above those previously associated with the visualizing community in general. We need to work toward a definition of these phenomena through additional research.

As educators, we need to understand how diagrammatics differ from traditional visualizers and nonvisualizers, particularly during the introduction and synthesis of conceptual material. Once identified, these idiosyncratic characteristics must become the subject for policies and procedures designed to facilitate the education and training of this subset of individuals.

Having walked the DV path, I suspect society will eventually conclude it to be a characteristic that has advantages and disadvantages. In any case, it has implications for design, presentation, facilitization, and evaluation of individuals possessing the quality.

This study has also caused me to consider exactly what it is about the inventive process that draws me to it, and once there, why do I find it so fascinating, so enjoyable, so all consuming? The only explanation I could discern, is the ability of the inventive act to focus and in some ways legitimize the experience of learning.

Invention is learning, specifically, learning and understanding the requirement;

learning the context and constraints; and learning, sorting, and prioritizing literally hundreds of facts and solutions. Invention is joy, frustration, and satisfaction; indeed, every human emotion that may be associated with learning, must also be attributed to invention. I take refuge in Green's (1966) assertion that behaviorists perceive problem solving as but an extension of learning, while information processors believe learning to be problem solving in disguise. My position will be forthcoming within a few years.

Current adult education theory suggests the adult learner knows what, when, and sometimes how to learn what he or she deems important. When the "how" is missing, a learning manager may facilitate the process. For me, in some abstract way, the process, indeed the act of pursuing a patent appears to substitute for the traditional learning manager. Through the personification of the PTO, the judgement and motivation that would typically be supplied by the learning manager is available. The final piece, the assistance a learning manager would provide in identifying the available learning resources is unavailable until after the first Patent Office Action, and then only on a limited basis. This potential void in support has never provided a significant problem. Some might argue that my lack of a formal learning manager has limited the range and depth of my processes and they may be correct; however, the process of learning how to find information is little different from any other learning opportunity, and frankly, provides a similar, sometimes even greater thrill of the metaphorical hunt and eventual "kill!"

Globally, I hope this experience will in some way further our understanding the of processes by which thought and eventual learning are experienced by the everyday adult. Perhaps some of the procedures that I have implemented during the analysis of this research will find applicability in other arenas. In retrospect, it appears a relatively simple process by which thought patterns and resultant activities can be better understood. At the time, there were significant hurdles to developing a viable analytic process for this volume of graphical data. If I had it to do over, I would adapt my computers for standard analog video output, and simultaneously record both video and audio activities during the 152 drawing hours. This is a natural extension of my processes, and would enhance the time dimension for a more precise articulation of the inventive experience.

Having been an active learner for as long as I can remember, and allegedly exhibiting inventive propensities which were identified and focused through early parental intervention, I would suggest that my perception of the typical learning activity is little different from any that I have experienced during any inventive experience. My perception of the learning "in" and "out" of the inventive process appears to be identical. Such an assertion has implications for both learners and inventors. The most obvious, is, why do we as a society insist upon separating the two? If we were to refocus our perception of inventors and see them as simply proficient learners, we might significantly increase our pool of inventive capacity. Granted, a learning manager would need to

provide initial insight into the interface between the learner and the PTO; however, this is a one-time occurrence that could quickly be understood and replicated for the masses. I can see no legitimate reason why inventors are held in high esteem by society. They may have simply discovered something that can be extrapolated to everyone, if we can find the concept palatable.

Implications for Supervisors of Inventors

Having had the opportunity to experience both sides of the management/employee equation, I must admit that being perceived as a creative person, when residing on either side of that fence, wasn't always a lot of fun. Recognizing that the bulk of my experience has been within the context of the monstrous federal bureaucracy, there have been but a few relatively isolated instances when my "creative" characteristics were perceived as an advantage. In those isolated instances, it was individuals, not the system as a whole, that understood, accepted, and attempted to capitalize on my propensities. In a majority of those cases, my perceptions (and I hope the general consensus) of the results were positive.

Bureaucracies and other large formal organizations seem to survive, sometimes even thrive, within the context of the conformist paradigm. There are some exceptions, however, where large corporations have realized their viability was in some way tied to change and innovation, and they somehow make it work. Of these, 3M is one of the most obvious (Anonymous, 1988).

To manage, or at best, to be responsible for creative people, can be an exercise in hope. First, hope that everything will be perceived as being under control by other portions of the organization; second, hope that they will consistently produce something of value that can be measured and tracked in today's matrix madness; and lastly, hope they will remain reasonably content and inconspicuous. There is little worse than a creative person out of control, since it is almost impossible to anticipate from which direction, and from what context, the disgruntled individual will approach.

I believe management should remain sensitive to the emotional involvement of the inventive individual. For most creative employees, I suspect that creativity, or inventiveness cannot be turned on and off like a faucet. Inventive progress is a product of a complex set of internal and external circumstances that may include individual self-perceptions, so fragile in composition and duration and so fundamental to the very essence of the holder, that sustainability of these attitudes and the accompanying characteristics is an all consuming process. The entire range of available human emotions may be simultaneously in play, resulting in an employee that wants to succeed and be perceived as valuable to the organization and himself, lives in constant fear of failure, and resents having to experience the conflict and discomfort all at the same time.

In addition, the inventive person may spend significant periods when little or no perceptible consequence is evident. Some refer to this as an incubation period. It may simply be the lack of the appropriate simultaneous circumstances to produce inventive

behavior. In any case, the employee is aware of his/her lack of productivity, and only the most secure will not be impacted by that lack. Understanding, rather than harassment, may be the key. If invention is the combining of a multitude of simultaneous emotions with an understanding of the problem and range of technically feasible solution sets, then management would be better served to assist in the bringing together the requisite information, while insulating the employee from the likely ravages of the organization culture.

Although the creative/inventive environment described above might be perceived as excessive in most organizations, particularly in times of downsizing and restructuring, I suspect the alternatives are even less pleasant. My observations of creative people cause me to suspect these individuals, when too closely controlled, react in negative ways. Management's typical response to employees with whom they don't identify, is one of control. It is a form of the classic, "I'll teach this person to be more like me, and everything will be all right." I believe a creative person, forced to modify his/her behavior to conform to an organizational norm, responds in a variety of negative ways. Over time, these cumulative negatives transform what was a valuable human resource into a corporate liability. To make matters worse, the creative individual may not lose his creative drive, simply mask it from management, while negatively redirecting it toward the organization and its products. I can think of few things more destructive than a creative person bent on retaliation. You can never be sure from what direction the next

action will come.

Implications for Society

When I began this research, I had anticipated this study could contain implications for a variety of situations, including insight for fellow inventors; perhaps a study in "how-to" for independent inventors; and potentially have impact on the creative process across the spectrum of DoD research facilities.

In retrospect, the results as defined by these implications could probably be considered a mixed bag. Was the product of my experience a cookbook of invention processes -- probably not. Did I identify, capture, and articulate the grand unified theory of creative endeavor as manifested in a Patent Application? Again, no. But let me back off from these lofty goals and consider exactly what this personal experience, indeed the experience of one person, might offer to the reader.

First, I hope my undertaking demonstrated the old adage (typically attributed to Thomas Edison), of invention consisting of 1% inspiration 99% perspiration. There was very little creative genius demonstrated here, but considerable intellectual and physical effort was expended by constantly searching for answers, for solutions, and sometimes the search was simply to understand the question. If I missed the mark on capturing the process, it was in the area of the physical demands necessary to produce PTO quality drawings on the computer. Perhaps it was a function of my software or equipment, but the process of drawing, shaping, and connecting lines to an accuracy of .0001 of an inch

took significant physical control.

Implications for Further Research

Having completed this endeavor, and with the benefit of hindsight, I believe there are several areas where additional research could produce dividends.

The most obvious of these may be the investigation of DVs for both strengths and weaknesses. We need to understand better how this processing technique impacts traditional educational curriculum, delivery, and evaluation mechanisms.

Assuming the ability to replicate similar experiments with inventors, I believe improvements in data collection and a more focused area of inventive activity could provide significant additional insight into the process.

As stated previously, an increase in sophistication of graphical data collection could remove the need for interpolation between establishment of DTG's. Dual cameras could also simultaneously capture physical, verbal, and graphical manipulation. Such data could be invaluable in determining environmental and contextual influences of the experience, and perhaps assist organizations in monitoring and remaining sensitive to seemingly idiosyncratic tendencies of inventive/creative employees. Colgrove (1970) suggested a similar course within the constructs of short term determinants of innovative behavior.

I would also recommend that future research strictly limit the area of inventive exploration than was experienced by this undertaking. The literature suggested the

inventor being researched be provided significant freedom within which to act. I believe much could be understood by requiring activity to be limited to a specific field of endeavor. Such limitation could concentrate the collection effort around the processes utilized to focus the initial (and where necessary, subsequent) decisions about solutions to posed problems.

Combined, the enhanced data collection and the more focused area of consideration would provide significant additional insight into what we currently understand about the inventive experience.

Specifically, the following questions should be considered for future research.

1.) Are there visualization strengths and weaknesses that can be identified with DV?

2.) Are there cognitive variations between those categorized as DV, and the population as a whole?

3.) What percentage of the total population might be classified as possessing DV characteristics?

Application of these Procedures for Future Research

Questions will be raised about the usefulness of these data when applied to other inventors. It was not my intent to provide generalizability between my context, both internal and external, and any other inventor. This was, and remains, a singular experience designed to better understand one unique inventor performing in a quasi-

unconstrained environment.

What I hope will be of value are the data collection and analysis techniques that emerged from this experience. They are not mature, by any definition, but I believe they do constitute a jumping off point in capturing and understanding this type of behavior.

As evidenced in Chapter 4, the mechanisms that eventually produced such solutions as the Thread Map and matrices were huge time sinks, and were frequently painful in their development. The process of reviewing the drawings during assignment of the coding scheme, and establishment of the reference areas, consumed almost the identical amount of time as producing the original drawings. The process by which they were developed provides the dual benefit of establishing finite mental processes, while simultaneously providing a familiarity and appreciation of the contained experience well beyond any other mechanisms that I had identified. The alpha coding process, be it far from perfect, provided the parameters by which the certain aspects of the drawing could be understood. The technique was not designed to be all inclusive, nor completely sensitive to the entire range of possible occupance. During the actual assignment of letters to each component in each reference area, I kept a log of all the instances where the convention was inadequate to capture all of the intellectual and physical processes that had occurred. A review of these data indicated that the primary insensitivity occurred when multiple identical parts existed within a reference area. Decisions between two parts was on a ranked order process with Change, Movement, Addition,

Reintroduction being the order of precedence. Duplicate parts were recorded using the highest appropriate code. The process was insensitive to multiples (more than two of a particular part) within a reference area. On those few instances when this occurred, the third part was unchanged. What was lost, if anything, was the record of total available data, since the Unchanged existence of these parts was not reflected within the total data set. The occupance of this situation was less than 3 one-hundredths of one percent, inadequate to cause significant change to the results.

What my data evaluation constructs provide is a mechanism to subdivide complex graphical experiences through a triangulated tracking process that includes the Thread Map, Reference Areas, and the Verbal transcripts. The matrices created in a spreadsheet for this effort, could better be constructed in a database tool during subsequent activity. The spreadsheet technique was an artifact of the developmental process, and once the activity had been committed to this format, it became a constraint that I worked around..

Looking at the inventive experience itself, I believe it noteworthy that the origin of the idea, the concept for a paint ball grenade, took only a few seconds, but required more than 150 hours of work to make it both producible and economically viable. Could it have been done in less? Probably, if trade-offs were made on durability and safety.

Business Versus Academic Considerations

A patent on this type of device would typically be a business decision that would include among other things, the difficulty of manufacture; likelihood of entrance into this

particular market by competitors; and the anticipated sales quantities of the product. My patent application was an artifact of the research, and would not necessarily have been sought under pure market conditions.

EndNotes

1. Similar definitions exist in literature produced subsequent to the Manual of Patent Examining Procedures. See MacKinnon (1970), Pg. 24 as example. Novel, adaptive to reality, and produced. In addition, see work of Stein (1963), "that process which results in a novel work that is accepted as tenable or useful or satisfying by a group at some point in time" (P. 218). Newell, Shaw, and Simon (1958) included 1. Product having novelty and value to thinker or culture; 2. product that is unconventional in the sense it requires modification or rejection of previously accepted ideas; 3. Product resulting from high motivation and persistence, either over a considerable span of time or at a high intensity; 4. Product resulting from formulation of a problem which was initially vague and ill-definition (Paraphrased from Taylor & Ellison, 1975).
2. "While having applied for a patent is no comprehensive determinant of whether an individual is an inventor, it [is] the only practical means of distinguishing individual inventors from the rest of society" (MacDonald, 1986, P. 202).
3. From General Information Concerning Patents, December 1990 by the U.S. Department of Commerce Patent and Trademark Office.
4. Material originally appeared in *American Psychologist*, 5, 444-454.
5. Original title from Ericsson, & Simon (1980). See this and Nisbett, & Wilson (1977) for in-depth discussion of verbal reports and associated mental processes.
6. See Data Collection Mechanisms (later in this Chapter) for techniques designed to minimize the impact of translation from image to language.
7. One of the most recent examples is Bukowski (1992) and his *Descriptive Self-Study of the Working Processes of a Conceptual Artist*.
8. Reflective is used here in the Non-Phenomenological sense.
9. Ethan, on no less than 1000 or so occasions.
10. See U.S. PTO's Guide to Patent Draftsmen, available from the USGPO.

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APPENDIX A

PATENT APPLICATION, ENTITLED
REUSABLE PAINT BALL GRENADE, RELOADABLE WITH STANDARD .68
CALIBER

PAINT BALLS

AND

FORMAL DRAWINGS

Patent Application of Craig L. Lush
for
Reusable Paint Ball Grenade, Reloadable with Standard .68 Caliber Paint
Balls

Cross References to Related Applications

None.

Background -- Field of Invention

This invention relates to marking devices, specifically to an improved recreational Paint Ball grenade that may be reloaded with .68 caliber paint balls, and reused.

Background -- Description of Prior Art

A Paint Ball grenade is a device by which quantities of paint are delivered and dispensed to a location remote from the user with the intent of eliminating an opponent from a recreational Paint Ball game. The generally accepted rules of Paint Ball preclude any participant from continuing to play subsequent to receiving a paint marking. Paint Ball is a relatively immature sport that simulates combat situations in a non-lethal environment. Other than the fundamental armament, the Paint Ball Gun, few complex devices have been developed.

Heretofore, Paint Ball grenades have been relatively crude devices, limited in design to a single usage. One such system, shown in U.S. Pat. No. 4, 932,672 is a grenade comprised of a length of rubberized material similar to a bicycle tire innertube, filled to excess capacity with paint, sealed on its ends, folded in the center, reinforced by a net wrap, and fitted with an electrical connector cap over the adjacent sealed ends. An automotive type cotter pin extends through the electrical connector, and with its associated pull ring, simulates the traditional grenade pin present in functioning military grenades. Instructions for this device require the user to "pull pin, remove cap," and note that the grenade "will go off on impact". Additional instructions suggest user shake grenade "before game use to dissolve sediment." The contents are dispensed with a flailing action in the immediate vicinity of its impact. Subsequent to this one time use, the player must retrieve, remove, and dispose of the rubber paint casing, as well as the cap and cotter pin which comprise the grenade.

Objects and Advantages

Accordingly, several objects and advantages of my invention are as follows: it provides superior size, weight and aerodynamic characteristics from the prior art; it has a

bail by which it may be secured and transported prior to use during a game; it may be stored unloaded in a wide variety of environments, unaffected by extreme heat or cold; it has a predetermined and predictable dispersal pattern; it is easily refillable and reusable in subsequent games; it cannot be reloaded and reused during a Paint Ball game by anyone not possessing the appropriate grenade pin, thereby reducing the possibility of being claimed and used against its owner; it has multiple safety interlocks to minimize inadvertent actuation, and physical restraints to preclude injury in the event of catastrophic failure; it has an adjustable actuator; may be easily uploaded to change or blend color combinations at will; and it contains an internal environmentally friendly renewable (resettable) power source facilitating its application as a mine-like device actuated by any of a variety of mechanical triggering mechanisms.

Still further objects and advantages will become apparent from a consideration of the ensuing description and accompanying drawings.

Brief Description of the Drawings

Figure 1a. is a front view of grenade in the loaded configuration with pin in the load/pull position.

Figure 1b. is a front view of grenade in the unloaded or functioned configuration.

Figure 2a. is a back view of grenade in loaded configuration with pin in the load/pull position.

Figure 2b. is a back view of grenade in the functioned or unloaded configuration.

Figure 3 is a top view of grenade in the loaded configuration with pin in the safe position and safety interlock handles engaged.

Figure 4 is a bottom view of grenade in the unloaded or functioned configuration.

Figure 5a. shows Section AA of grenade in the loaded configuration with pin in the safe position.

Figure 5b. shows Section BB of grenade in the unloaded or functioned configuration.

Figure 6a. is a view of center post displaying the rear of the actuator mechanism.

Figure 6b. is a view of the center post displaying the front of the actuator mechanism.

Figure 6c. is a view of the center post displaying the side of the actuator mechanism.

Figure 6d. shows the center post with top view of exploded actuator mechanism.

Figure 6e. shows Section DD, a top view of actuator mechanism within the center post.

Figure 7a. is a top view of the grenade pin.

Figure 7b. is a front view of grenade pin.

Figure 7c. shows Section EE, a cross-section of the grenade pin cam.

Figure 8. shows Section CC of grenade, including top view of finger guard with the safety interlock pins in the "at-rest" position.

Figure 9a. is a front view of the loading door.

Figure 9b. is a side view of the loading door.

Figure 9c. is a top view of the loading door.

Figure 9d. is a back view of the loading door.

Figure 9e. shows Section FF of the loading door in a vertical position.

Figure 9f. is a side view of the loading door showing action of loading door safety interlock.

Figure 9g. is a side view of the loading door showing safety interlock pendulum at maximum travel, perpendicular to the loading door.

Figure 9h. is a side view of the loading door demonstrating maximum travel of safety interlock pendulum.

Figure 10 is a side view of the grenade, showing travel of the loading door and default position of safety interlock pendulum.

Figure 11 shows an exploded view of Section AA with finger guard rotated 90 degrees to demonstrate position of loading door.

List of Reference Numerals

- 20 Center Post
- 21 Center Post Spherical Top
- 22 Center Post Base
- 24 Center Post Thru-Hole for Power Spring Retaining Pin
- 26 Center Post Notch for Safety Interlock Pin
- 28 Center Post Thru-Hole for Grenade Pin
- 30 Center Post Thru-Hole for Actuator Mechanism
- 32 Actuator Adjusting Screw
- 34 Actuator Spring
- 36 Actuator Washer
- 38 Actuator Ball
- 40 Actuator Adjustment Marking
- 44 Power Spring Retaining Pin
- 45 Retaining Pin Installation Hole
- 46 Washer
- 48 Power Spring Guard
- 50 Power Spring
- 54 Pin
- 56 Pull Ring
- 58 Cam
- 62 Safety Interlock Pin
- 64 Safety Interlock Handle
- 66 Retaining Clip
- 68 Safety Interlock Spring
- 72 Cap
- 73 Load/Pull Pin Orientation Marking
- 74 Cap Threads
- 75 Safe Pin Orientation Marking

76 Cap Thru-Hole for Grenade Pin
 78 Cap Thru-Hole for Center Post
 80 Cap Neck-down Actuator Interface
 82 Cap Bearing Surface for Center Post
 84 Bail
 86 Shoulder Screw
 90 Upper Housing
 92 Upper Housing Threads
 94 Upper Housing Thru-Hole for Safety Interlock Handle
 95 Finger Guard Door Hinge Slot
 96 Finger Guard
 97 Loading Door Closure Tab
 98 Finger Guard Paint Dispersal Port 99 Loading Door Safety Cam
 100 Loading Door
 101 Loading Door Paint Port
 102 Loading Door Hinge Pin
 103 Loading Door Safety Interlock Pendulum
 104 Loading Door Safety Interlock Stop
 105 Loading Door Finger Tab
 107 Finger Guard Blind-hole for Ball Cutter
 108 Finger Guard Void for Ball Cutter Retainer Displacement
 109 Finger Guard Race for Ball Cutter Retainer
 110 Safety Interlock Housing
 112 Bolt
 114 Captured Locking Nut Assembly
 116 Ball Cutter
 118 Core
 119 Core Thru-Hole for Center Post
 120 Core Retaining Screw
 121 Ball Cutter Retainer
 122 Ball Cutter Retainer Thru-Hole for Core
 124 Finger Guard Retaining Screw
 126 Paint Ball
 128 Lower Housing
 130 Foot
 132 Lower Housing Thru-Hole for Center Post
 136 Lower Housing Drain Hole
 138 Liner
 140 Liner Paint Ball Race
 142 Liner Thru-Hole for Center Post
 144 Liner Drain Holes

Summary - The object of my invention is a paint ball grenade for the dispersal of paint from .68 caliber or smaller paint balls through a spring powered crushing action, and controlled by a variable, mechanical actuator mechanism.

Description of Invention - Preferred Embodiment

Figure 1a. shows a plain front view of a paint ball grenade in the loaded configuration with pin installed and in the load/pull configuration. This view is suitable for publication in the Gazette.

Figure 1b. is a front view of a paint ball grenade as shown in figure 1a. This view depicts the unloaded or functioned configuration. The grenade is comprised of a cylindrical center post (20) passing longitudinally through the grenade. A center post base (22) exists at the bottom, or base end of center post (20) and center post spherical top (21) exists at the opposite, or uppermost end of center post (20). Located within center post (20), directly below spherical center post top (21) is the actuator mechanism that will be fully discussed in figure 6. Actuator ball (38), and actuator adjustment marking (40) are visible in figure 1b. A handle or bail (84) is attached to cap (72) by means of a shoulder screw (86) at the terminating ends of bail (84). A load/pull pin orientation marking (73) is visible adjacent to cap thru-hole for grenade pin (76). Cap (72) is attached to upper housing (90) by means of cap threads (74) and upper housing threads (92) which will be discussed in figure 11. A retaining pin installation hole (45) is also visible on upper housing (90). Three safety interlock handles (64) are visible extending through the upper housing (90) above the finger guard (96). Finger guard paint dispersal port (98) extend through the finger guard (96). A loading door (100) is attached to finger guard (96). The lower housing (128) is visible extending below the finger guard (96). A foot (130) extends below the lower housing (128). Various configurations of Foot (130) may be produced separately and attached to the lower housing (128) or may exist integrally as a result of the lower housing (128) production.

Figure 2a. is a rear or back view of a paint ball grenade in the loaded configuration with pin (54) in the load/pull position as evidenced by the orientation of pull ring (56). Spherical center post top (21) protrudes above the top edge of cap (72). A center post base (22) is again evidence at the bottom of the device, exterior to lower housing (128) adjacent to and forming a common bottom plane with foot (130). Finger guard (96) showing configuration of finger guard paint dispersal port (98) on the back side of grenade is also displayed. Two safety interlock handles (64), visible from the back, protrude through upper housing (90). Cap (72) displays safe pin orientation marking (75). Bail (84) is attached to cap (72) by Shoulder screw (86) at the terminating ends of bail (84). A retaining pin installation hole (45) is also visible on upper housing (90).

Figure 2b. is a back view of a paint ball grenade in the functioned or unloaded configuration. The grenade is comprised of a cylindrical center post (20) passing longitudinally through center of the device and protruding above the top edge of cap (72). Located within center post (20) and below spherical center post top (21) is the actuator mechanism that will be discussed in figure 6. Actuator ball (38), and actuator adjustment marking (40) are visible in figure 2b. A center post base (22) is again evidenced at the bottom of the device, protruding below the lower housing (128) adjacent to and forming a common bottom plane with foot (130). The finger guard (96) showing configuration of finger guard paint dispersal port (98) on the back side of the device is also displayed. Two safety interlock handles (64), visible from the back, protrude through the upper housing (90). Cap (72) displays the safe pin orientation marking (75) adjacent to the cap thru-hole for grenade pin (76). Bail (84) is attached to cap (72) by Shoulder screw (86) at the terminating ends of bail (84). A retaining pin installation hole (45) is also visible on upper housing (90).

Figure 3 is a top view of a paint ball grenade in the loaded configuration with pin (54) in the safe position as evidenced by orientation of pull ring (56). Center post (20) is visible beneath bail (84) and within cap (72). Three safety interlock handles (64), displayed in the engaged position, and retaining pin installation hole (45) are visible on upper housing (90). Finger guard (96) displays loading door hinge pin (102) positioned within the finger guard door hinge slot (95). Loading door (100) and loading door safety cam (99) are visible protruding from finger guard (96).

Figure 4 is a bottom view of a paint ball grenade in the unloaded or functioned configuration. Four each foot (130) are located adjacent to center post base (22). Four each lower housing drain hole (136) are shown on the lower housing (128). Three safety interlock handles (64) in the at-rest position are visible above finger guard (96). Loading door (100), loading door safety cam (99), and loading door finger tab (105) protrude from finger guard (96).

Figure 5a. shows section AA (Figure 3) of grenade in the loaded configuration with pin (54) in the safe position as evidenced by orientation of pull ring (56) and cam (58) interlocked with center post thru-hole for grenade pin (28). Center post (20), having a center post notch for safety interlock pin (26), a center post base (22), and spherical center post top (21) extends longitudinally through the device. Cap (72) contains longitudinal cap thru-hole for center post (78) with a cap neck-down actuator interface (80) below cap bearing surface for center post (82). Cap neck-down actuator interface (80) retains the spring loaded actuator ball (38) prior to functioning. Bail (84) is attached to cap (72) by means of a shoulder screw (86) at the terminating ends of bail (84). Upper housing (90) contains a retaining pin installation hole (45). Finger guard (96) displays Finger guard paint dispersal ports (98) and provides location and position for ball cutter

(116) and a finger guard void for ball cutter retainer displacement (108). Directly below Finger guard void for ball cutter retainer displacement (108) and contained within vertical walls of finger guard (96) is housed a ball cutter retainer (121). Above finger guard (96), and attached with bolt (112) and captured locking nut assembly (114), is a safety interlock housing (110). Safety interlock housing (110) retains safety interlock handle (64) attached to safety interlock pin (62) and safety interlock spring (68). A retaining clip (66) is attached to safety interlock pin (62) and limits travel of safety interlock pin (62) and safety interlock handle (64). Below finger guard (96), and attached with core retaining screw (120), is a core (118). Multiple paint balls (126) may be contained between core (118) and the vertical wall of finger guard (96). Above core (118) and surrounding center post (20) is a washer (46), a power spring (50), a power spring guard (48), and a second washer (46) which are held in place with a power spring retaining pin (44) which passes thru center post (20). Attached to the top surface by liner retaining screw (146), and contained within lower housing (128) is liner (138). A liner paint ball race (140) is contained within the top surface of liner (138). A foot (130) is attached to lower housing (128) adjacent to center post base (22).

Figure 5b. shows section BB (Figure 4) of a paint ball grenade in the unloaded or functioned configuration as evidenced by the extension of center post (20) and center post spherical top (21) above cap (72) and the absence of paint ball (126) between the liner paint ball race (140) and ball cutter retainer (121). Power spring (50) is extended and power spring guard (48) precludes the engagement of safety interlock pin (62) with safety interlock handle (64) into the now misaligned center post notch for safety interlock pin (26). Safety interlock spring (68) maintains safety interlock pin (62) against safety interlock housing (110), limited by retaining clip (66). Safety interlock housing (110) is attached to top horizontal surface of finger guard (96) by bolt (112) and captured locking nut assembly (114). Center post thru-hole for grenade pin (28) extends above cap (72) and actuator ball (38) is disengaged from cap neck-down actuator interface (80). Center post (20) now extends from center post base (22) between foot (130) and below lower housing (128) thru cap bearing surface for center post (82). Cap thru-hole for grenade pin (76) is empty and bail (84) extends above cap (72) and over center post (20), being attached to cap (72) by means of a shoulder screw (86) at the terminating ends of bail (84). Power spring retaining pin (44) is installed through retaining pin installation hole (45) in upper housing (90). Power spring retaining pin (44) retains washer (46) and power spring guard (48) against top of power spring (50), while lower washer (46) rests between bottom of power spring (50) and the inner or top horizontal surface of core (118). Core (118) is attached to lower horizontal surface of finger guard (96) by core retaining screw (120). Finger guard (96), containing finger guard paint dispersal ports (98), is attached to the lower surface of upper housing (90) and contains on its lower horizontal surface ball cutter (116), finger guard void for ball cutter retainer displacement (108), and a finger guard race for ball cutter retainer (109). Liner (138) is attached to

lower housing (128) with liner retaining screw (146).

Figure 6a. is a back view of the center post (20) showing center post thru-hole for grenade pin (28), spherical center post top (21), actuator adjusting screw (32), and actuator adjustment marking (40).

Figure 6b. is a front view of center post (20) showing the center post thru-hole for grenade pin (28), spherical center post top (21), and actuator ball (38).

Figure 6c. is a side view of center post (20) showing center post thru-hole for grenade pin (28), spherical center post top (21), actuator ball (38), and actuator adjustment marking (40).

Figure 6d. is an exploded top view of actuator components, including actuator adjusting screw (32), actuator spring (34), actuator washer (36), and actuator ball (38) as they are assembled within center post thru-hole for actuator mechanism (30), of center post (20).

Figure 6e shows Section DD (Figure 6c), of center post (20) with actuator adjusting screw (32), actuator spring (34), actuator washer (36), and actuator ball (38).

Figure 7a. is a top view of pin (54), showing pull ring (56), and cam (58).

Figure 7b. is a front view of pin (54), showing pull ring (56), and cam (58).

Figure 7c. shows Section EE (Figure 7b.) of cam (58), with pin (54), and pull ring (56).

Figure 8 shows Section CC (Figure 2b.) including top view of finger guard (96) thru sectioned upper housing (90). Evident are safety interlock housing (110), bolt (112), captured locking nut assembly (114), safety interlock pin (62), Safety interlock handle (64), Retaining clip (66), and safety interlock spring (68). Center post (20) with power spring retaining pin (44), washer (46), and power spring guard (48) are also visible. New to this view is the location of finger guard retaining screw (124), which attaches finger guard (96) to the upper housing (90). Also visible are location and frequency of core retaining screw (120), and ball cutter (116). Loading door (100), loading door safety cam (99), loading door hinge pin (102), and finger guard door hinge slot (95) are also visible.

Figure 9a. is a front view of loading door (100), which includes loading door safety cam (99), loading door hinge pin (102), loading door paint port (101), Loading door closure tab (97), and loading door finger tab (105).

Figure 9b. is a side view of loading door (100), which includes loading door safety cam (99), loading door hinge pin (102), loading door paint port (101), Loading door closure tab (97), and loading door finger tab (105).

Figure 9c is a top view of loading door 100, which includes loading door safety cam 99, and loading door hinge pin 102.

Figure 9d is a back view of loading door 100, which includes loading door safety interlock pendulum 103, loading door paint port 101, loading door closure tab 97, and loading door finger tab 105.

Figure 9e. shows Section FF (Figure 9a.), of loading door (100). It includes loading door safety interlock pendulum (103), loading door safety interlock stop (104), loading door safety cam (99), and loading door finger tab (105).

Figures 9f-h demonstrate the loading door safety interlock pendulum (103) travel limitation. Also included are loading door closure tab (97), loading door safety cam (99), loading door hinge pin (102), loading door safety interlock pendulum (103), loading door safety interlock stop (104), and loading door finger tab (105).

Figure 10 is a side view of a paint ball grenade showing travel of loading door (100) and loading door safety interlock pendulum (103) during initial preparation for reloading paint ball (126). Included is loading door safety cam (99) and its relationship to safety interlock handle (64) thru upper housing (90). Pin (54) is in the load/pull position as evidenced by pull ring (56). Bail (84) is attached to cap (72) by shoulder screw (86). Load/pull pin orientation marking (73) and safe pin orientation marking (75) are indicated on cap (72). Relationship of safety interlock pin (62) to center post (20) is shown. Paint ball (126) may be seen behind finger guard (96) and thru finger guard paint dispersal port (98). Lower housing (128) displays foot (130) placement and location of center post base (22).

Figure 11 shows an exploded view of Section AA (Figure 3) with Finger guard (96) rotated (90) degrees to demonstrate position of loading door (100) and loading door safety interlock pendulum (103). Beginning at the top with bail (84) assembled to the cap (72) with shoulder screw (86). Cap (72) displays the longitudinal cap thru-hole for center post (78), the transverse cap thru-hole for grenade pin (76), as well as cap neck-down actuator interface (80), Cap bearing surface for center post (82), and male cap threads (74). Male cap threads (74) engage female upper housing threads (92) of upper housing (90) during assembly. Pin (54), with cam (58) and their relationship to pull ring (56) is also provided. Safety interlock handle (64) is attached to safety interlock pin (62), assembled thru safety interlock spring (68) and into safety interlock housing (110) before

being secured with retaining clip (66). Safety interlock handle (64) is installed through upper housing thru-hole for safety interlock Handle (94) and safety interlock housing (110) secured to finger guard (96) with bolt (112) and captured locking nut assembly (114). Finger guard (96), contains finger guard paint dispersal port (98) and finger guard blind-hole for ball cutter (107), into which Ball cutter (116) is installed. Finger guard (96) also includes finger guard void for ball cutter retainer displacement (108), and provides finger guard race for ball cutter retainer (109), into which ball cutter retainer (121) is inserted. The bottom surface of ball cutter retainer (121) provides the upper surface for retaining paint ball (126). Core (118) is secured to the base of finger guard (96) in the center void of ball cutter retainer thru-hole for core (122). Core (118) is secured to finger guard (96) with core retaining screw (120). Loading door (100), with loading door safety cam (99) are attached to finger guard (96) with loading door hinge pin (102). Lower housing (128) contains lower housing drain hole (136), lower housing thru-hole for center post (132) and foot (130). Installed above and within lower housing (128) is liner (138). Liner (138) contains liner paint ball race (140), liner drain holes (144), liner thru-hole for center post (142), and is attached to lower housing (128) with liner retaining screw (146). Liner paint ball race (140) of liner (138) provides the lower surface for retaining paint ball (126). Center post (20), with its center post base (22), center post thru-hole for power spring retaining pin (24), center post notch for safety interlock pin (26), center post thru-hole for grenade pin (28), center post thru-hole for actuator mechanism (30) terminates at the spherical center post top (21). Contained with center post thru-hole for actuator mechanism (30) of center post (20) is Actuator adjusting screw (32), actuator spring (34), actuator washer (36), and actuator ball (38). Power spring retaining pin (44) is installed thru retaining pin installation hole (45) of upper housing (90) and captures upper washer (46), power spring guard (48), power spring (50), and lower washer (46) above the core (118) as center post (20) passes thru core thru-hole for center post (119).

Description of Invention - Alternative Embodiments

As a Prepositioned Mine - A chord or wire may be secured to the Pull ring (56) so that the mechanical displacement of the pin (54) by pulling the wire would cause immediate functioning of the device.

As a Dispersal Device for Chemical or Biological Agents - The object of my invention may also be employed as a dispersal device for chemical or biological agents by employing .68 or smaller diameter capsules that have been filled with one or more of a variety of chemical agents.

Operation of Invention - Preferred Embodiment

Operation of my grenade is presented in five sequential procedures: inspection prior to use; resetting the power spring (50); uploading paint balls (126); deployment; and adjusting actuator sensitivity.

Prior to use, all parts must be inspected to assure they are fully functional and free of dried paint. User should assure the free movement of safety interlock handles (64). Pin (54) should be available and undamaged. Actuator mechanism should be operational with adjusting screw (32) installed and actuator ball (38) clean and properly seated. Loading door (100) should be fully operational, free of accumulated paint with hinge (102) operational. Loading door safety cam (99) should engage and advance safety interlock handle (64). Loading door safety interlock pendulum should be free of dried paint, operating freely with safety interlock stop (104) operational.

Resetting power spring (50) is accomplished by grasping finger guard (96) with palm of hand while applying minimal force upon one or more safety interlock handles (64). Rotate bail (84) in either direction until transverse to longitudinal axis of grenade. Invert grenade and press center post spherical top (21) on hard surface. Force center post (20) into grenade until perimeter of center post spherical top (21) is flush with top of cap (72). As power spring (50) is compressed actuator ball (38) will engage cap neck-down actuator interface (80). One or more safety interlock handles (64) will engage center post notch for safety interlock pin (26). Insert pin (54) into cap thru-hole for pin (76) with the plane created by the pull ring (56) perpendicular to the grenade's longitudinal axis. Once inserted, rotate pin (54) until plane created by pull ring (56) is positioned parallel to longitudinal axis of grenade.

Load paint balls (126) after power spring (50) has been reset. Pin (54) and associated pull ring (56) must be rotated until plane created by pull ring (56) is perpendicular to longitudinal axis of grenade. Grenade length will increase slightly as the pin (54) cam (58) rotates to the load/pull position. Growth results in distance between top surface of liner (138) and the bottom surface of ball cutter retainer (121) increasing sufficiently to allow insertion of paint ball (126). Grasp finger guard with palm of hand, center post base (22) closest to loader's body, loading door (100) away from palm. Using loading door finger tab (105) open loading door (100) pivoting upward toward top of grenade. Loading door (100) will snap open as loading door closure tabs (97) disengage from the finger guard (96). As loading door (100) opens, loading door safety interlock pendulum covers opening and minimizes possibility of crush injury should other safety devices catastrophically fail. When loading door (100) reaches full travel, safety interlock handle (64) engages center post notch for safety interlock pin (26). Once loading door (100) is fully opened, loading door safety interlock pendulum (103) must be pivoted upward into loading door (100). Paint balls (126) may now be inserted into the opening created by loading door (100). When complete, loading door (100) should be closed until loading door safety interlock pendulum covers opening in finger guard (96), to preclude inadvertent insertion of fingers into paint ball (126) area. Pin (54) pull ring (56) should then be rotated 90 degrees (in either direction) causing pin (54) cam (58) to interlock with the spring loaded center post (20) precluding the inadvertent extraction of pin (54) while causing distance between the upper surface of the lower housing (128) liner (138) and the bottom surface of the ball cutter retainer (121) to be decreased sufficiently for paint balls

(126) to align themselves in liner paint ball race (140). Alignment of paint balls (126) in liner paint ball race (140) simultaneously positions paint balls within functional proximity of ball cutter (116). Loading door should now be closed and snapped shut as loading door closure tabs (97) engage opening for loading door (100) in finger guard (96).

Deployment - grenade is typically worn onto playing field attached by bail (84) to various types of snap hooks on vest or belt. Deployment procedure involves removing grenade from vest or belt, grasping grenade with finger guard (96) in palm of hand while simultaneously pressing (engaging) one or more safety interlock handles (64). Rotate pin (56) pull ring (58) until plane created by pull ring (56) is perpendicular to the longitudinal axis of grenade. While maintaining engagement of one or more safety interlock handles, remove pin (56). As grenade travels downrange, spring loaded safety interlock handles (64) previously depressed will retract (disengage). Power spring (50) will be restrained by engagement of actuator ball (38) against cap neck-down actuator interface (80). Upon adequate jarring impact, the relationship between the two grenade halves, specifically those components attached to and including the upper housing (90) and those components attached to and including the lower housing (128) and center post (20) will change slightly. The distortion occurring at the minimal clearances that exist between center post (20) and core thru-hole for center post (119) and cap bearing surface for center post (82). Such distortion when combined with jarring action, causes the potential of compressed power spring (50) to overcome resistance created by actuator spring (34) causing spring loaded actuator ball (38) to retract into center post (20) thus allowing power spring (50) to expand. Expansion of power spring (50) causes liner (138) to close with ball cutter retainer 121. Continued compression of the paint balls (126) will cause ball cutter retainer (121) to deflect into finger guard void for ball cutter retainer displacement (108), exposing paint balls (126) to ball cutters (116) thus breaching the integrity of the paint ball (126) membrane. Orientation of paint balls (126) within the liner paint ball race (140) is irrelevant due to the total quantity and locations of the ball cutters (116). Simultaneous membrane breach reduces total potential required from power spring (50) to accomplish mission while minimizing potential delta in necessary crushing force created by inconsistencies in paint ball membranes. Continued expansion of power spring causes pressurization of released paint between liner (138), ball cutter retainer (121), and interior of finger guard (96). Acting as a non-positive displacement pump, continued closure of the liner (138) and ball cutter retainer (121) forces paint through finger guard paint dispersal ports (98), which have been designed to maximize the tradeoff between volume and dispersal distance. Core (118) acts as the upper housing (90) component terminus for the power spring while increasing the volumetric paint dispersal efficiency of the device. Alignment between the upper housing (90) and associated parts, and lower housing (128) and center post (20) and their collective associated parts, is provided by liner thru-hole for center post (142), core thru-hole for center post (119) and cap bearing surface for center post. Potential misalignment between the two housing halves requires clearance exist between core (118) and liner (138). This clearance allows

pressurized paint to pass into the base of the liner (138), potentially preventing the complete closure of liner (138) and ball cutter retainer (121). Blow-by paint, accumulating in the base of liner (138) may drain into lower housing (128) through liner drain holes (144) and out of lower housing (128) through lower housing drain holes (136). Upon complete compression of paint balls (126) by the power spring (50), between liner paint ball race (140) and ball cutter retainer (121), the residual membranes collect in the liner paint ball race (140), thus maximizing the potential of the device. Subsequent to deployment and functioning, the power spring (50) can be reset and residual paint ball (126) membranes removed with the assistance of a small stick through the loading door (100), by rotating the lower housing (128) and associated parts in relationship to the upper housing (90) and associated parts. Care should be taken to assure one or more of the safety interlock handles (64) are completely engaged before introducing any foreign device into the paint ball (126) area.

Adjust actuator setting - actuation sensitivity adjustments may only be done when the device is in the unloaded/functioned configuration. Procedure is accomplished by manipulation of the actuator adjusting screw (32) in order to increase or decrease the compression on actuator spring (34), thus increasing or decreasing the force necessary to cause the actuator ball (38) to retract into the center post (20), thus allowing the power spring (50) to function the device. Permanent actuator adjustment markings (40) on the center post (20) indicate direction actuator adjusting screw (32) must be turned to increase or decrease the sensitivity of the actuator mechanism.

Operation of Invention - Alternative Embodiments

As a Prepositioned mine - the object of my invention may also be used as a prepositioned mine by screwing actuator adjuster screw (32) counterclockwise until the force placed upon actuator spring (34) is inadequate to preclude the power spring (50) from causing the device to function. By eliminating the actuator ball's (38) resistance, the loaded device, when secured appropriately to produce the desired dispersal effects, will function when the pin (54) is removed. To do this remotely, in person, or with trip wire, the pin (54) pull ring's (56) plane must be perpendicular to the longitudinal axis of the grenade. A chord or wire may be secured to the pull ring (56) so that the mechanical displacement of the pin (54) by pulling the wire would cause immediate functioning of the device.

Dispersal device for chemical agents - the aforementioned paint ball grenade may be employed to deliver and disperse a variety of flammable or chemical agents by law enforcement or government military organizations. Any .68 or smaller capsule may be loaded into the device for remote deployment without the complications of explosive timing devices typically necessary in the dispersal of chemical substances. Conceivably the device could be utilized for the deployment of lethal and nonlethal binary chemical and biological weapons currently under development. The advantage to this design is its simplicity and lack of expensive mechanical fuze-like timing mechanism that are highly susceptible to the corrosive characteristics of many of today's chemical munitions.

Conclusions, Ramifications, and Scope

Accordingly, it can be seen that my invention provides numerous advantages over the prior art. They include but may not be limited to: its superior size, weight and aerodynamic characteristics; its incorporation of a bail by which it may be secured and transported prior to deployment; it may be stored in a wide variety of environments, unaffected by extreme heat or cold until after it is uploaded; it has a predetermined and predictable dispersal pattern; it is easily refillable and reusable; it cannot be reloaded and reused during a Paint Ball game by anyone not possessing the appropriate grenade pin, thereby reducing the possibility of being claimed and used against its owner; it has multiple safety interlocks to minimize inadvertent actuation and physical restraints to preclude injury in the event of catastrophic failure; it has an adjustable actuator; it can be easily uploaded to change or blend color combinations at will; and it contains an internal environmentally friendly renewable power source that facilitates its use as mine-like device actuated by any of a variety of mechanical triggering mechanisms.

Although the description above contains many specificities, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Various other embodiments and ramifications are possible within its scope. For example, it may have applications in a variety of civil law enforcement, and even military environments. When uploaded with other than standard paint balls (126), the device has application as a neutralizing agent for chemical spills, or even a fire extinguisher that could be loaded, targeted, deployed, and actuated under extreme conditions. The size of the device may be varied to accommodate a variety of individualized applications, while the capacity of the munition (preferred embodiment was paint ball (126)) may be varied without direct relationship with overall device size. Composition of device can vary in accordance with available materials and economic considerations. A variety of man made and naturally occurring, or combination of the two could be employed during construction. The device could be made completely of nonmetallic materials if nondisclosure by metal detectors was advantageous.

Thus the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

Reusable Paintball Grenade, Reloadable with Standard .68 Caliber Paintballs.

Abstract:

A reusable, mechanically powered Paint Ball Grenade designed to be reloaded with .68 or smaller diameter paint balls. Possessing an adjustable actuator mechanism and a variety of safety interlock devices, the unit has superior size, weight and aerodynamic characteristics over previous designs. Incorporating a bail by which it may be secured and transported, it may be stored in a wide variety of environments, unaffected by extreme heat or cold until uploaded. It has a predictable dispersal pattern, is easily refilled but cannot be reloaded and reused during a Paint Ball game by anyone not possessing the appropriate grenade pin. Using standard paint balls, it can be uploaded to change or blend color combinations. Internal triggering and power sources facilitate its use as a mine-like device when actuated remotely.

Reusable Paintball Grenade
C.L.Lush

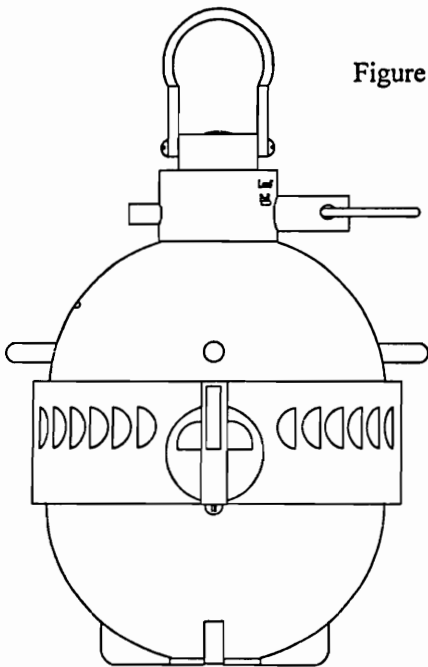


Figure 1a.

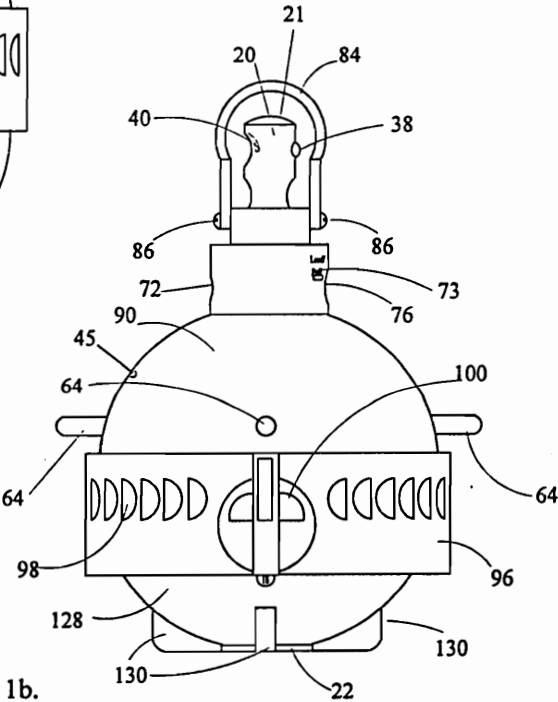


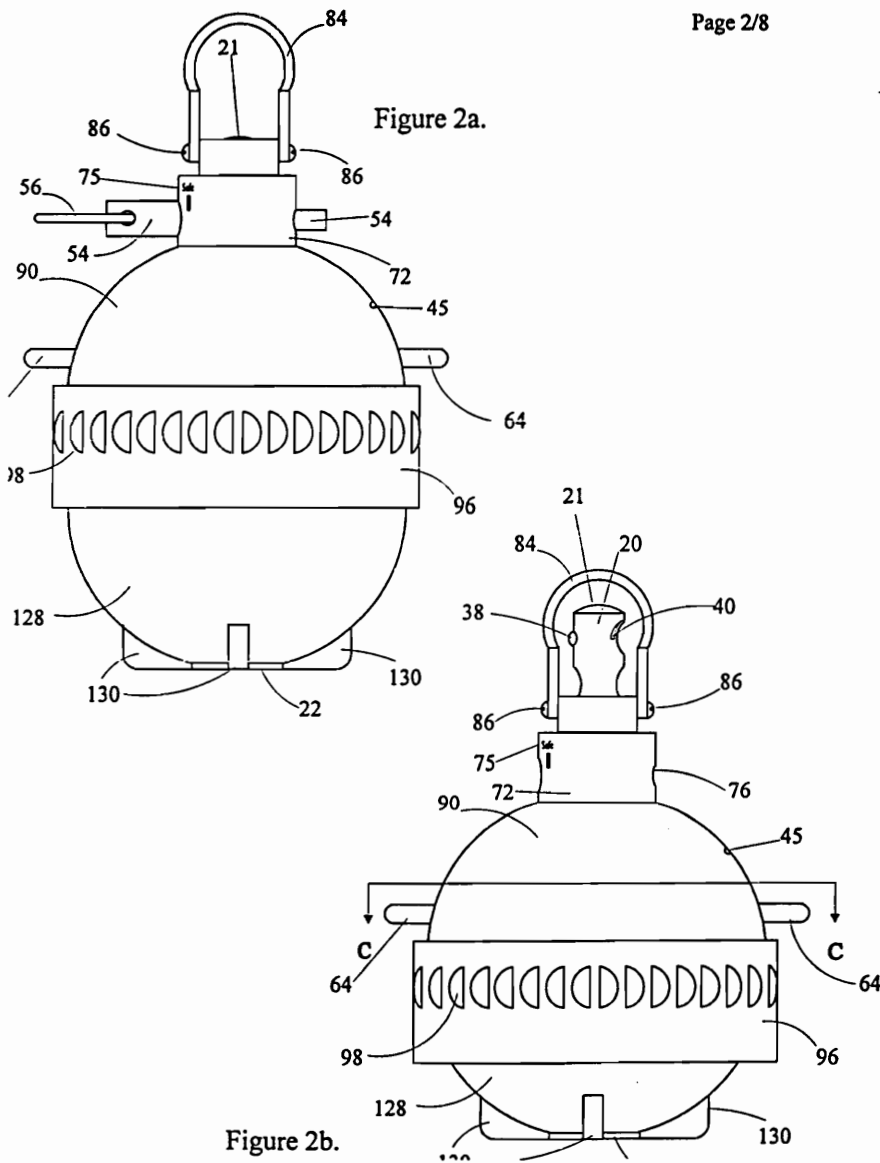
Figure 1b.

Reusable Paintball Grenade

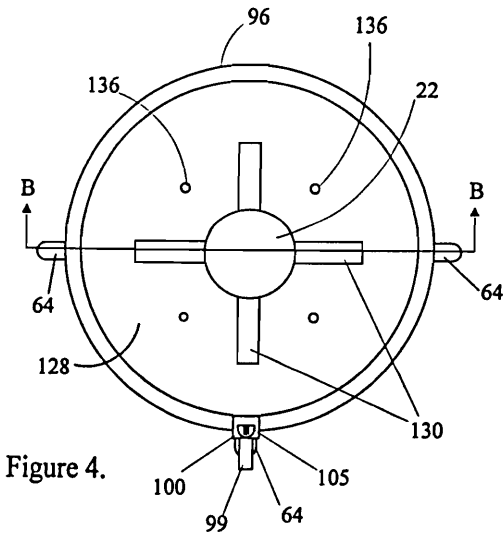
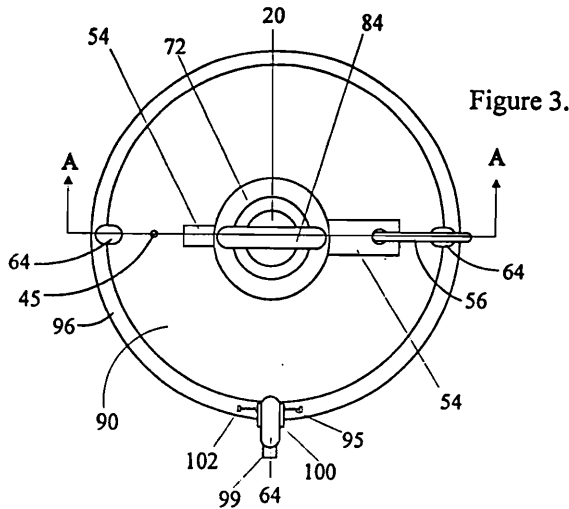
C.L.Lush

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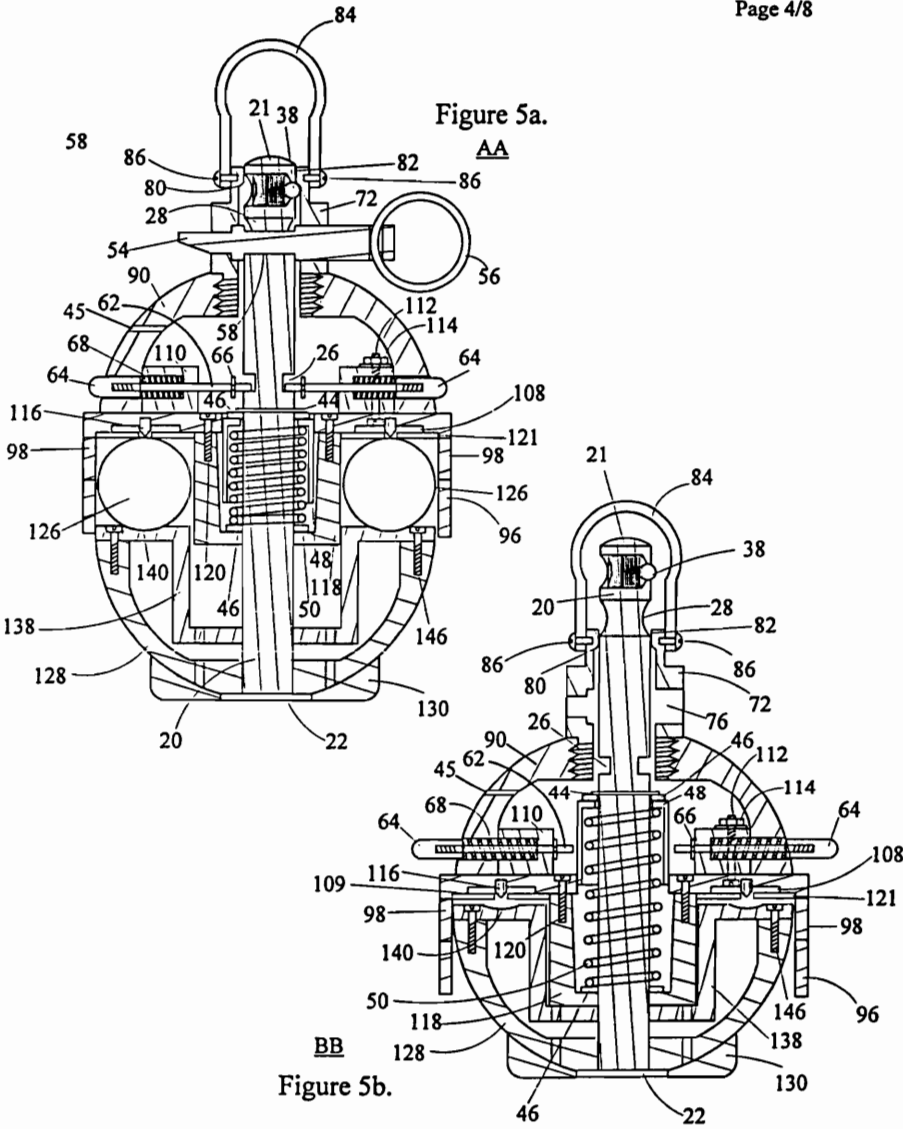
Reusable Paintball Grenade
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Reusable Paintball Grenade C.L.Lush

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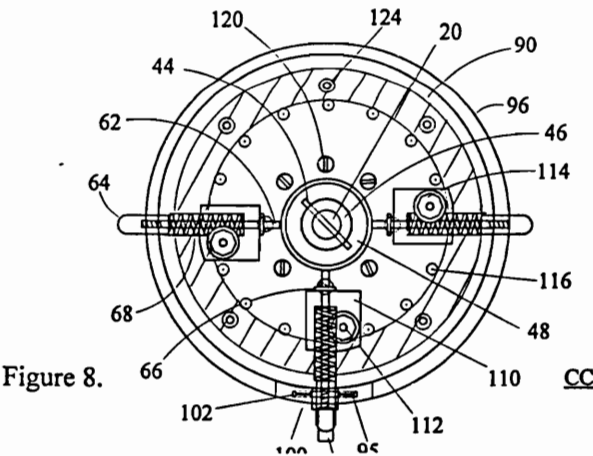
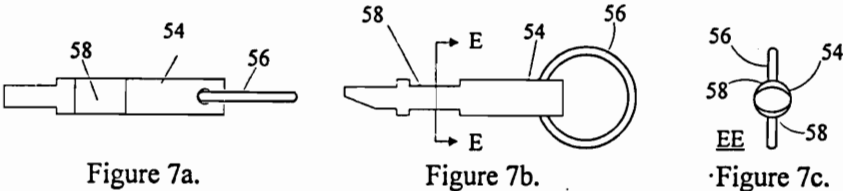
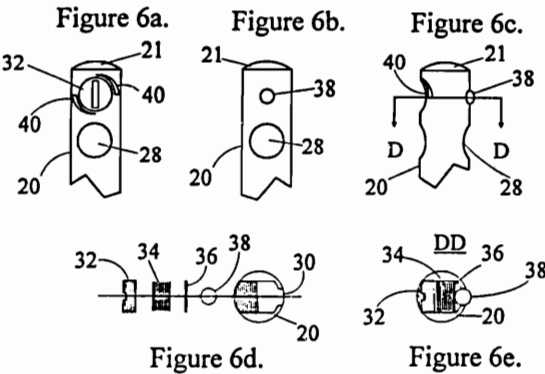
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Reusable Paintball Grenade C.L.Lush

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Reusable Paintball Grenade
C.L.Lush

Figure 9a.

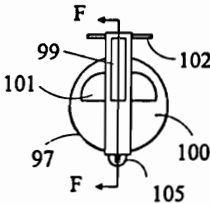


Figure 9b.

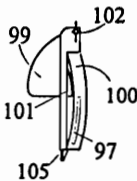


Figure 9c.

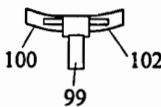


Figure 9d.

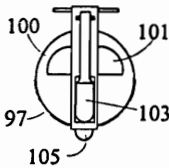


Figure 9e.

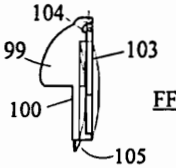


Figure 9f.

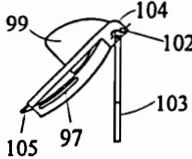


Figure 9g.

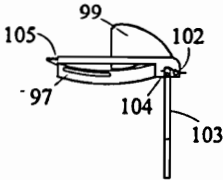
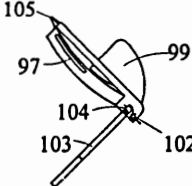
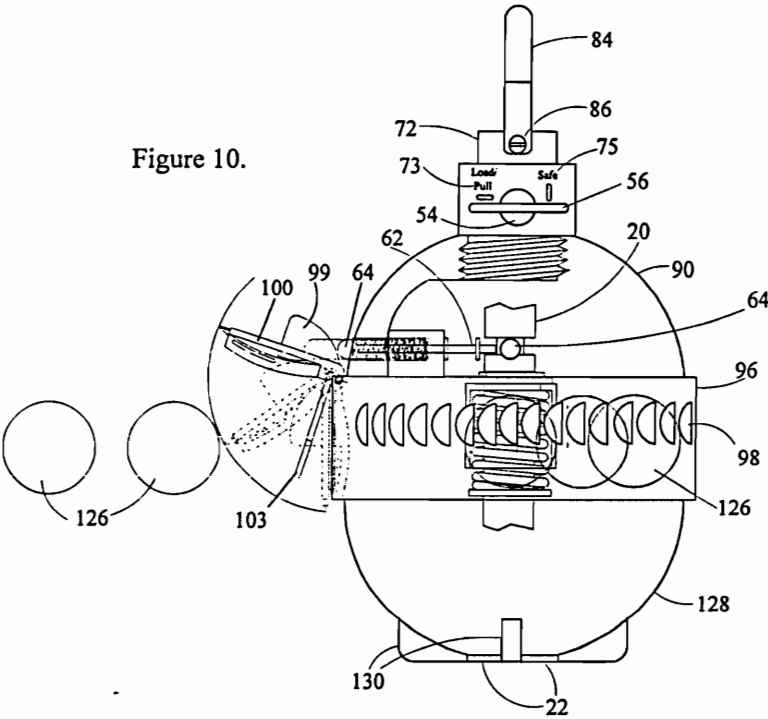


Figure 9h.



Reusable Paintball Grenade
C.L.Lush



Reusable Paintball Grenade C.L.Lush

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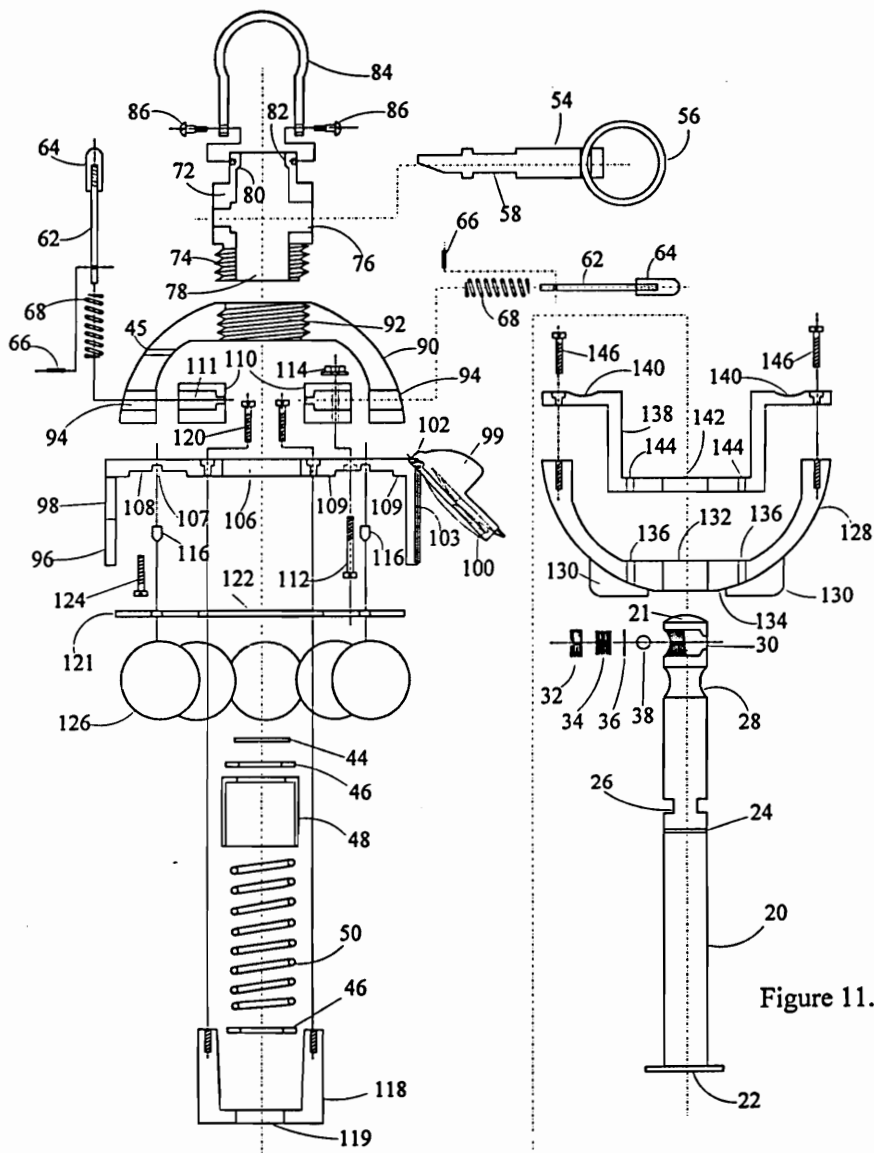


Figure 11.

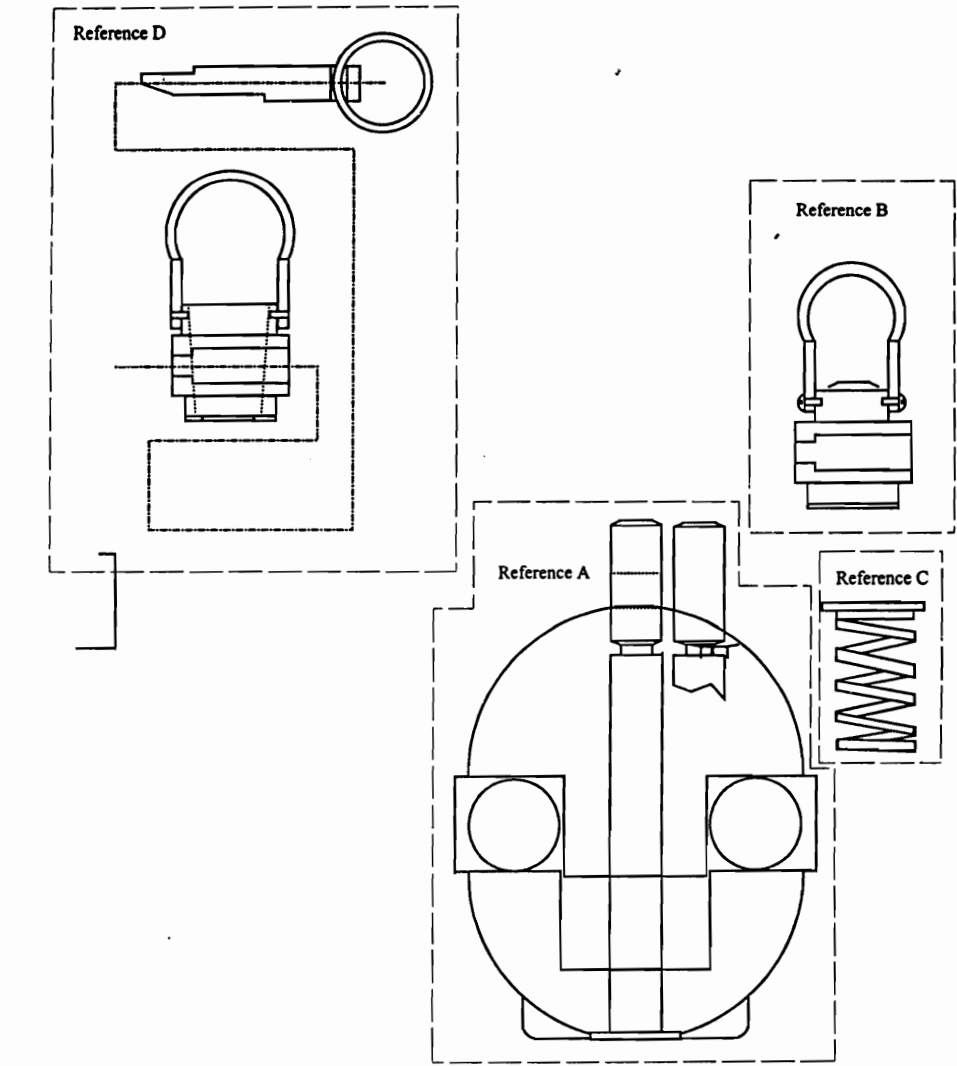
APPENDIX - B

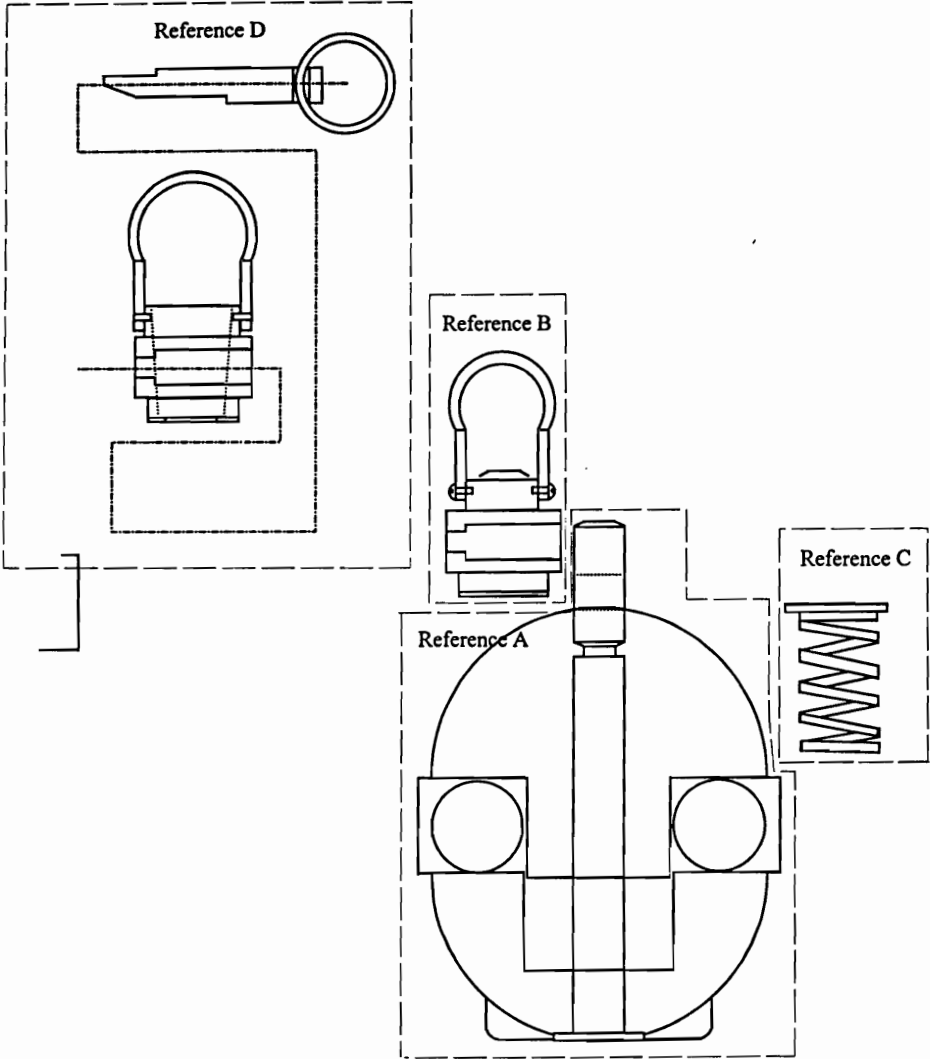
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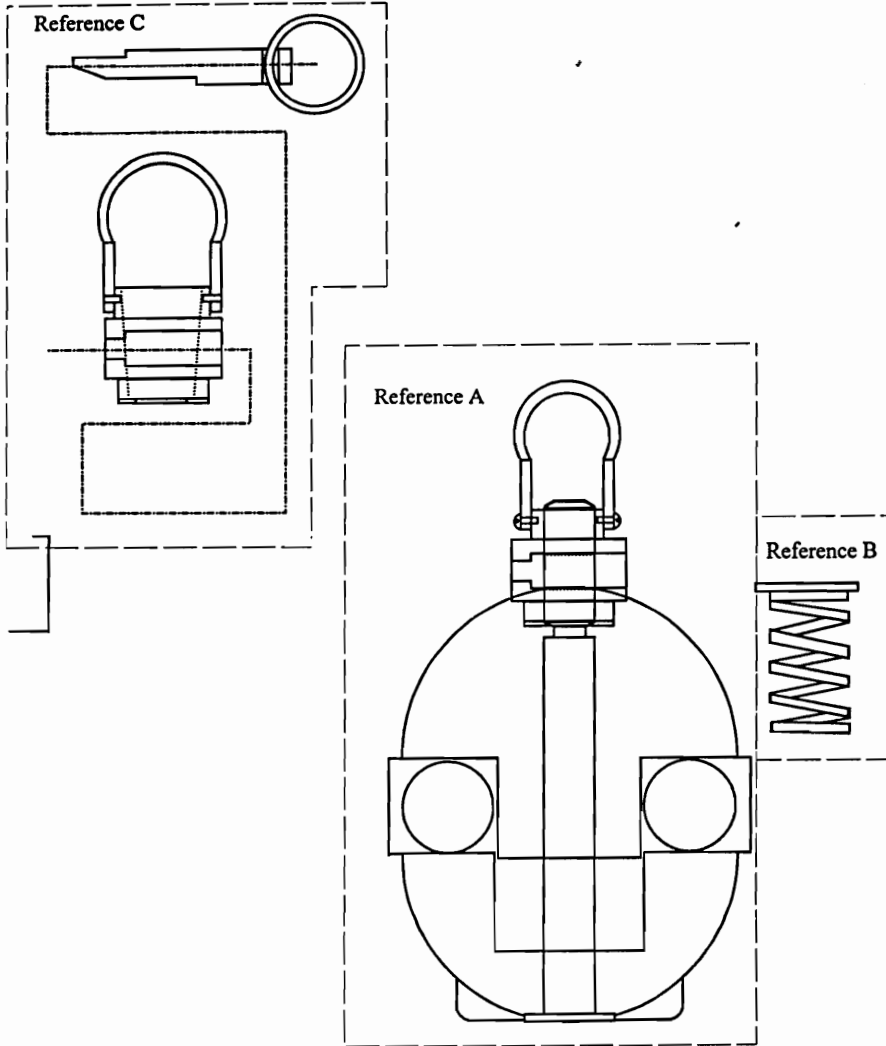
APPENDIX - C

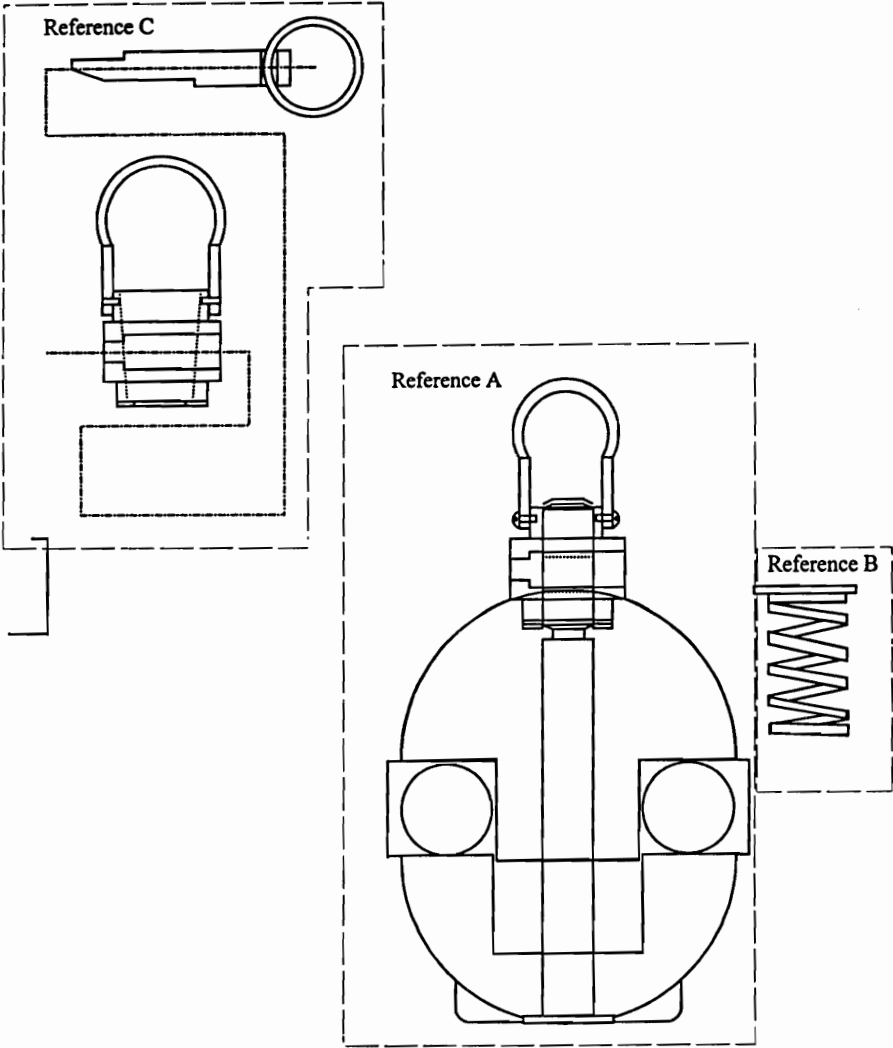
NINETY-ONE* DEVELOPMENTAL DRAWINGS DISCUSSED IN CHAPTER FOUR, RESULTS OF THIS STUDY

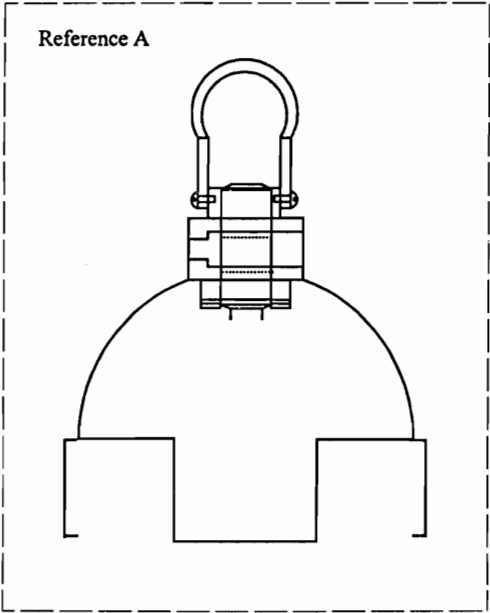
*The drawings contained within this Appendix retain their original Date Time Group (DTG) nomenclature located in the upper left hand corner of each drawing.

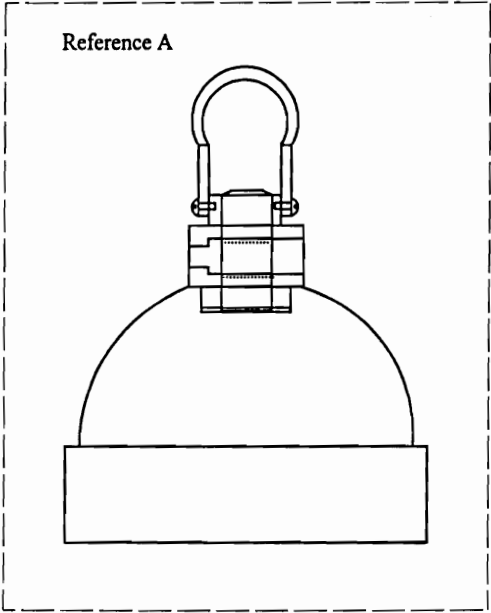


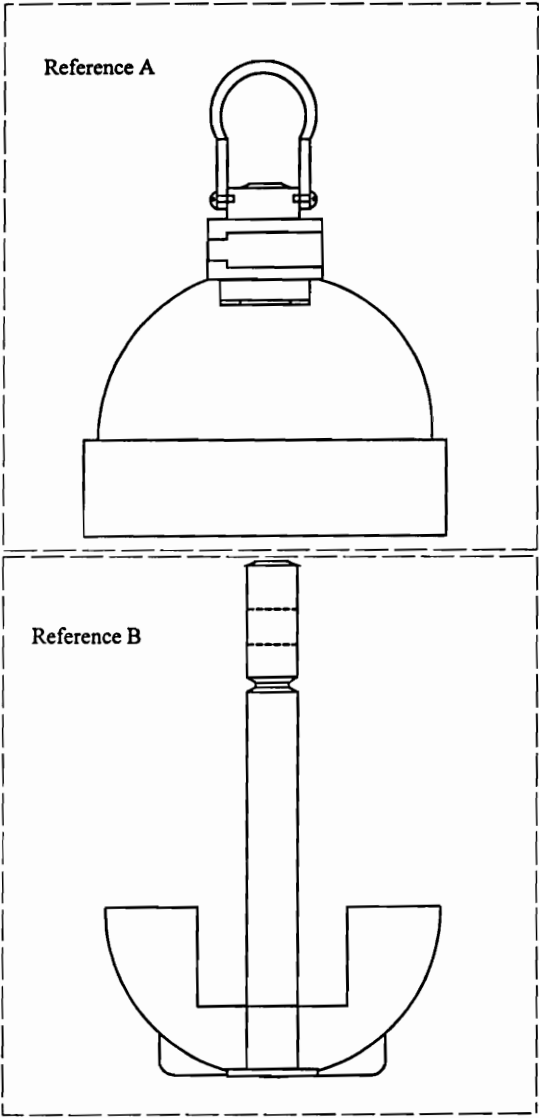


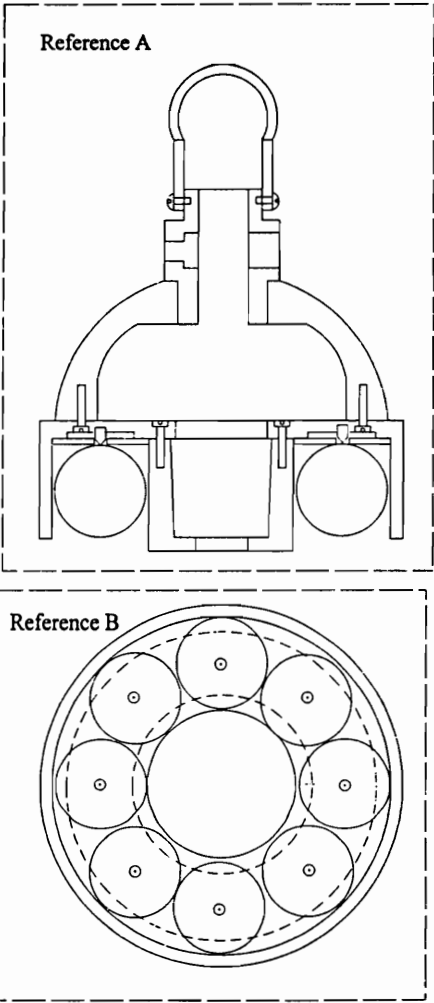


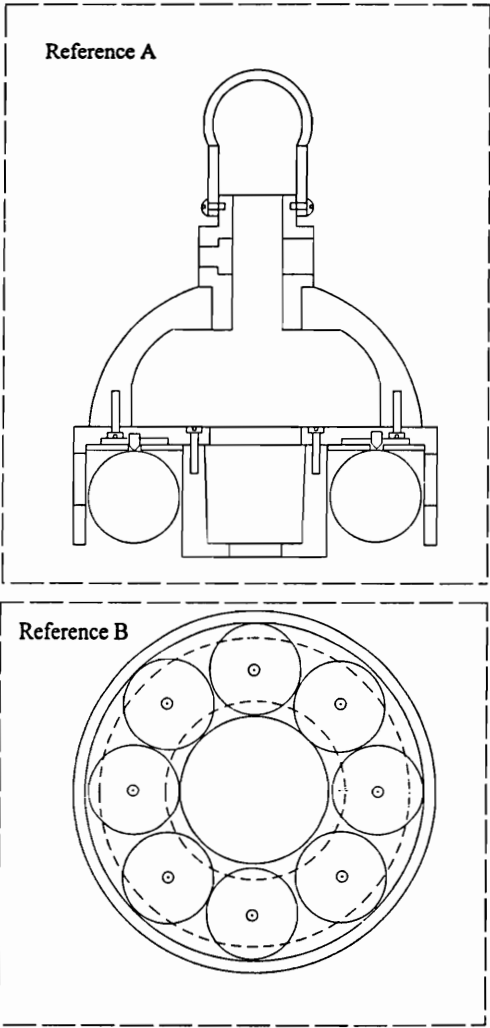


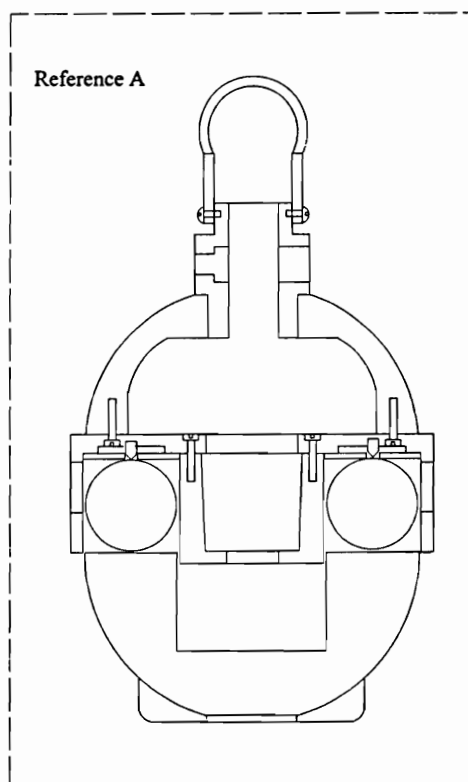


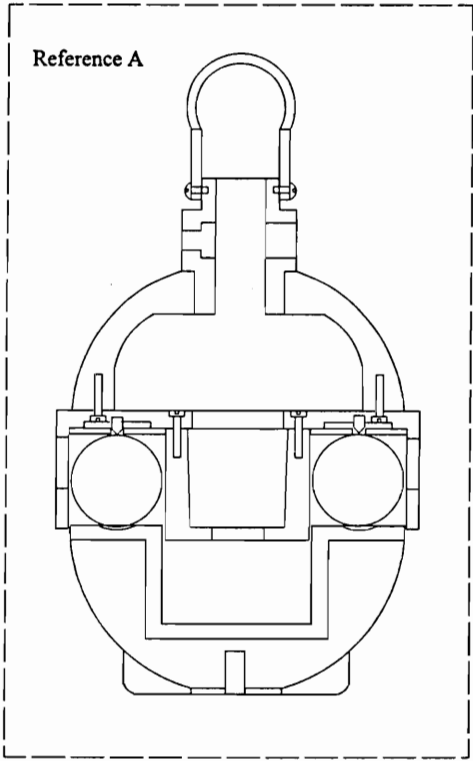


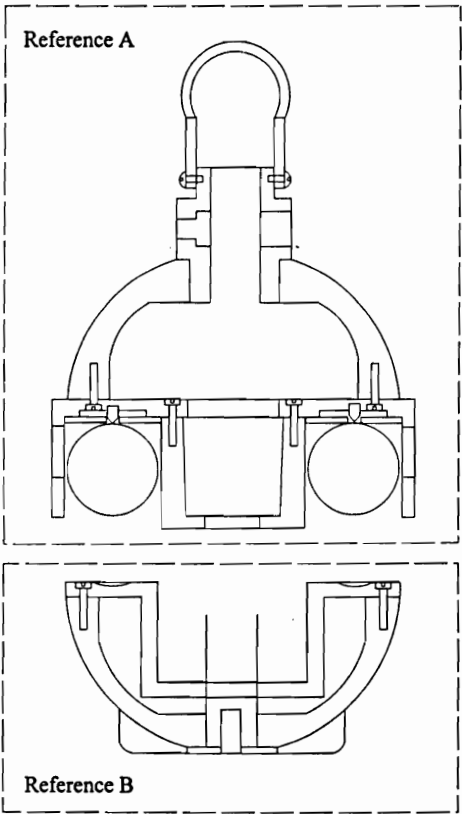


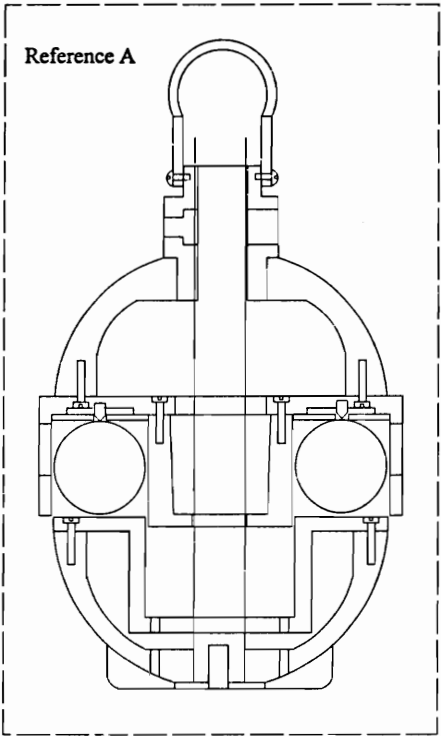


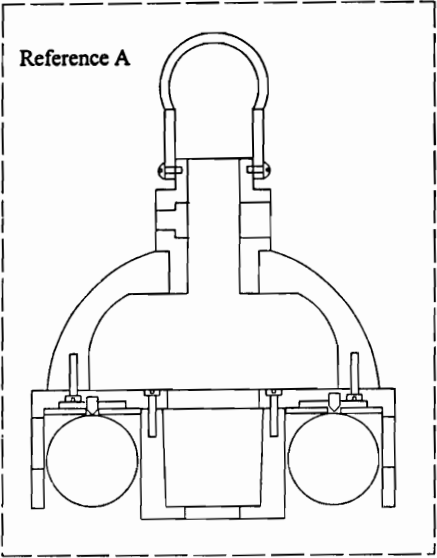


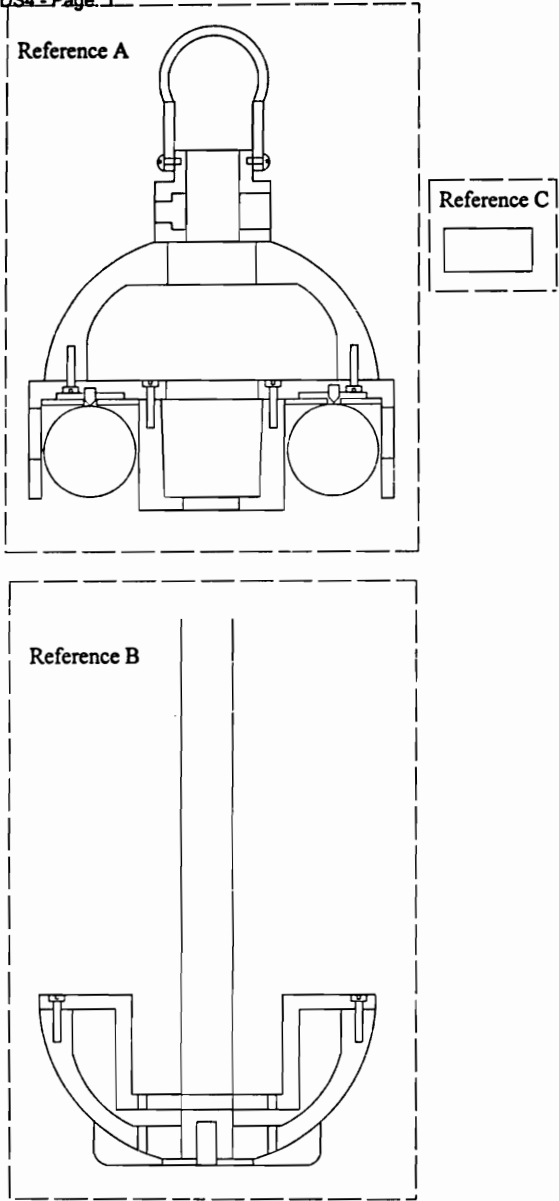


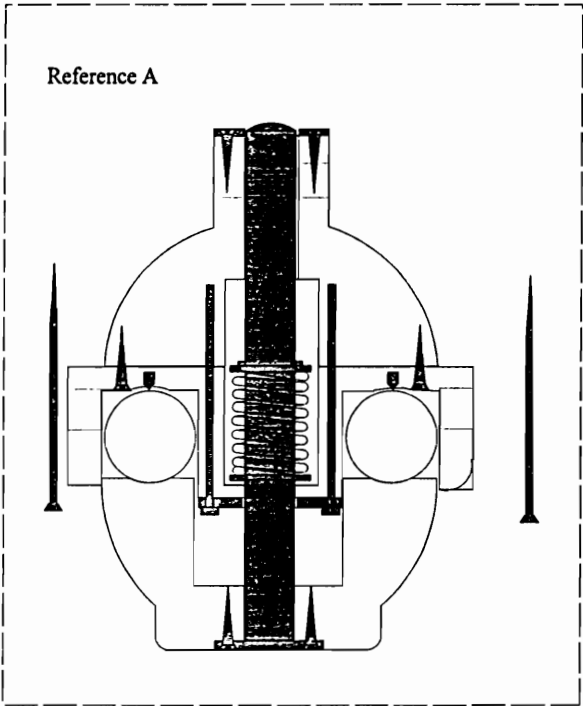


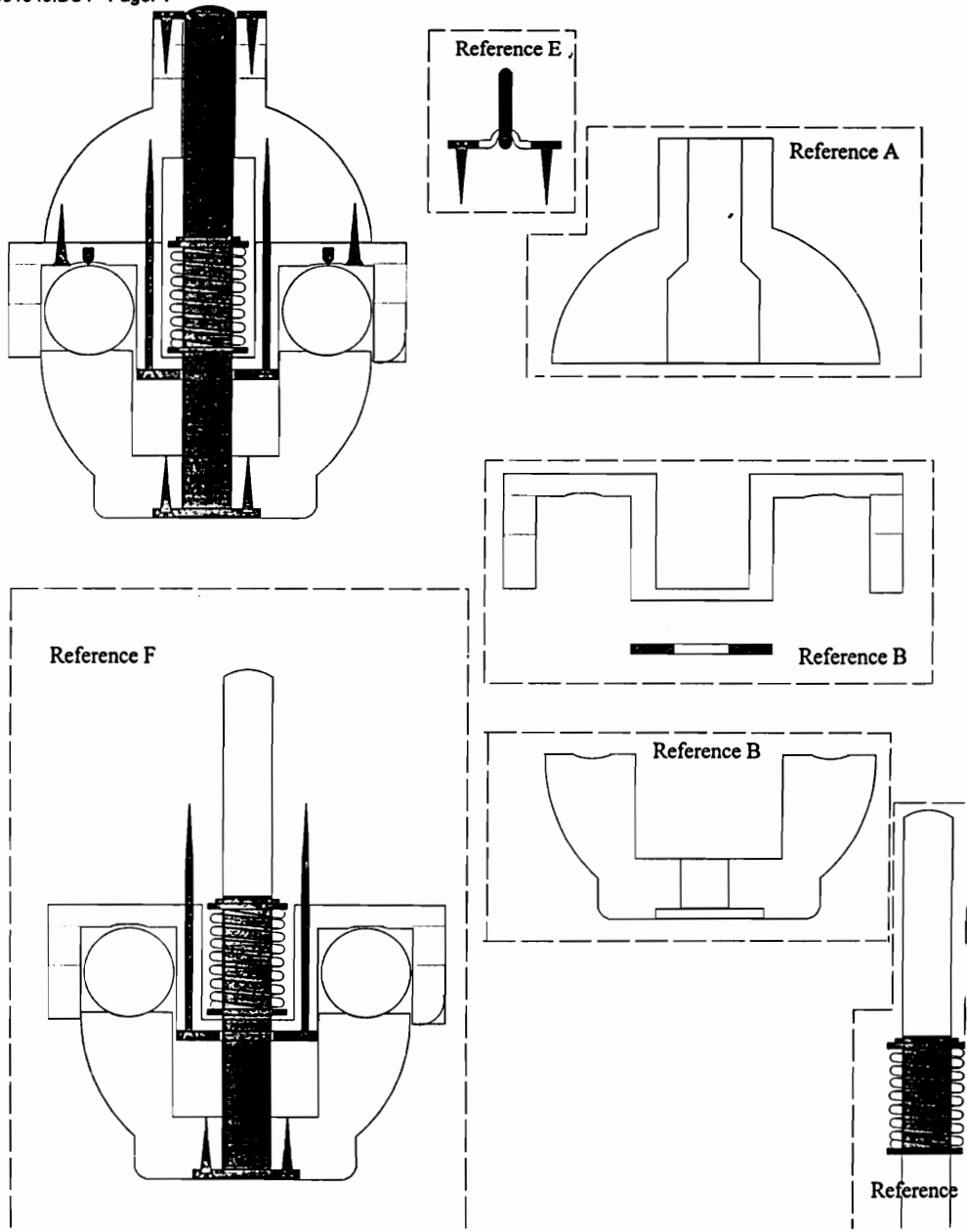


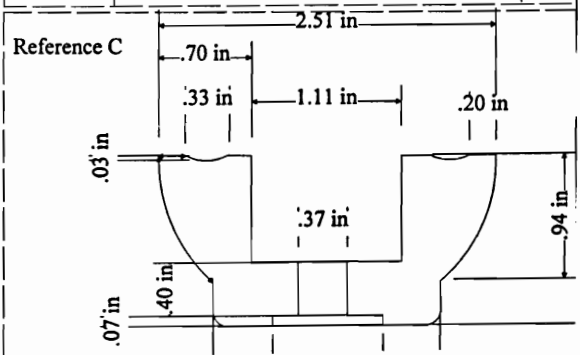
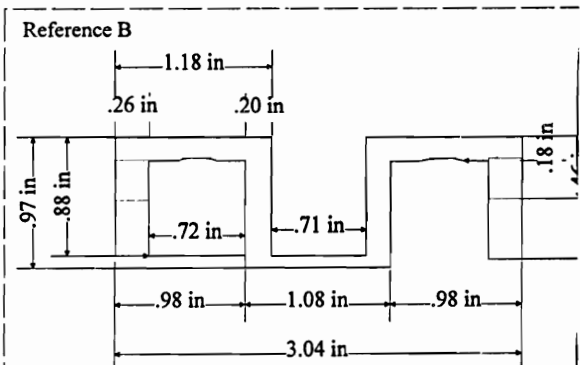
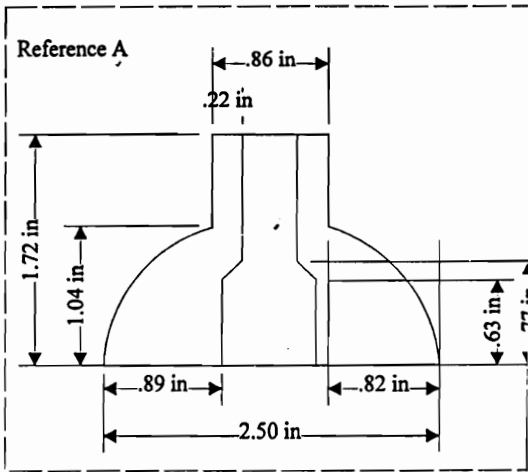
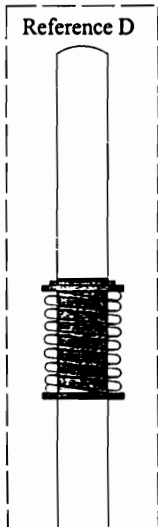
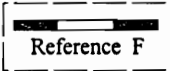
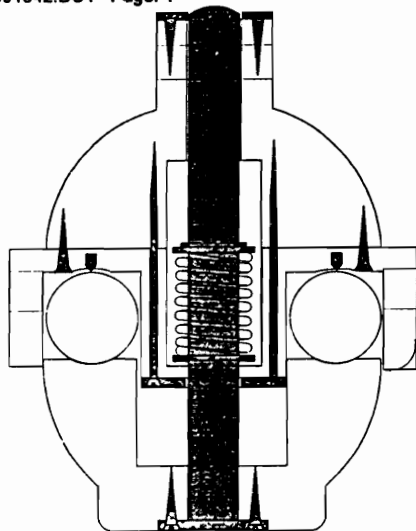


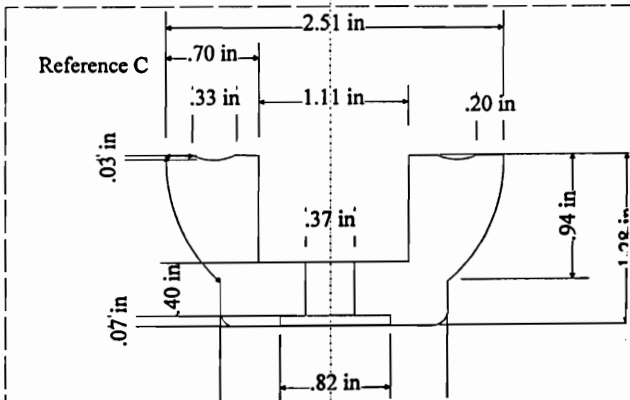
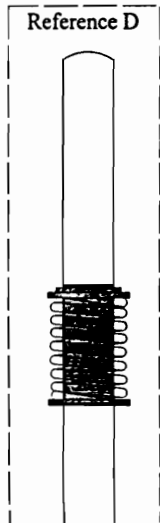
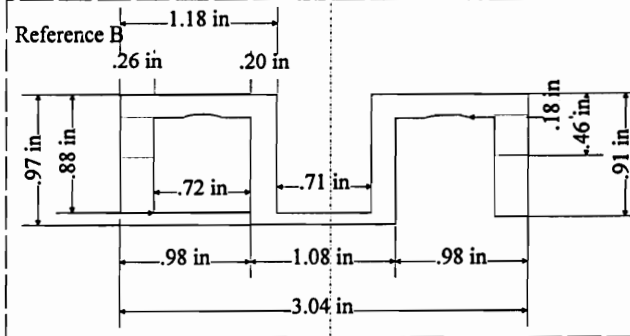
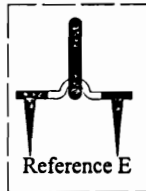
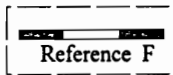
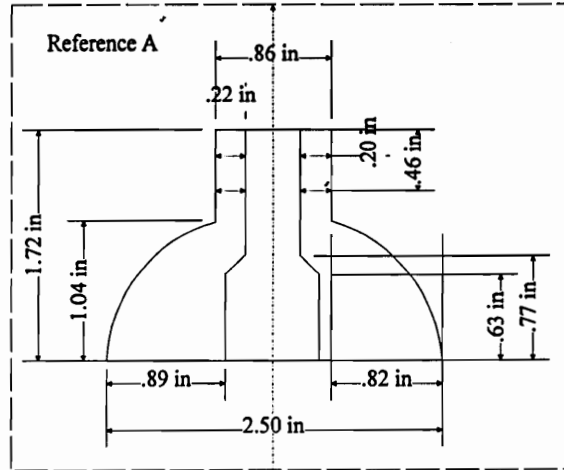
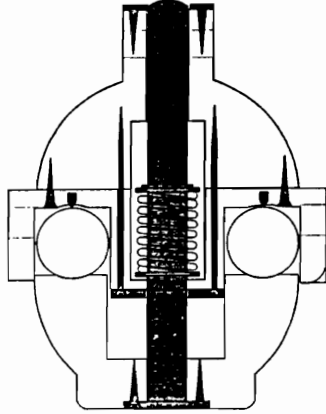


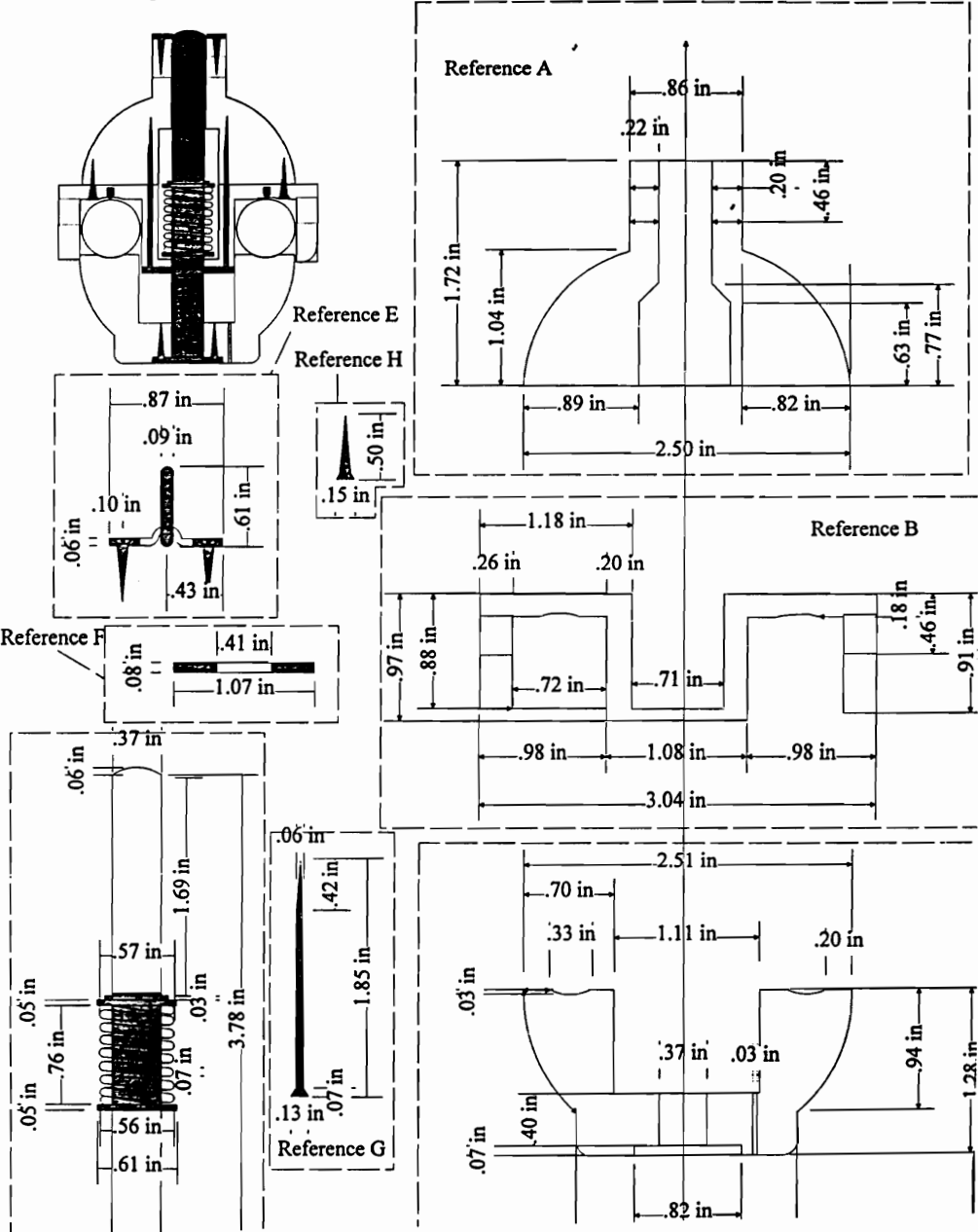




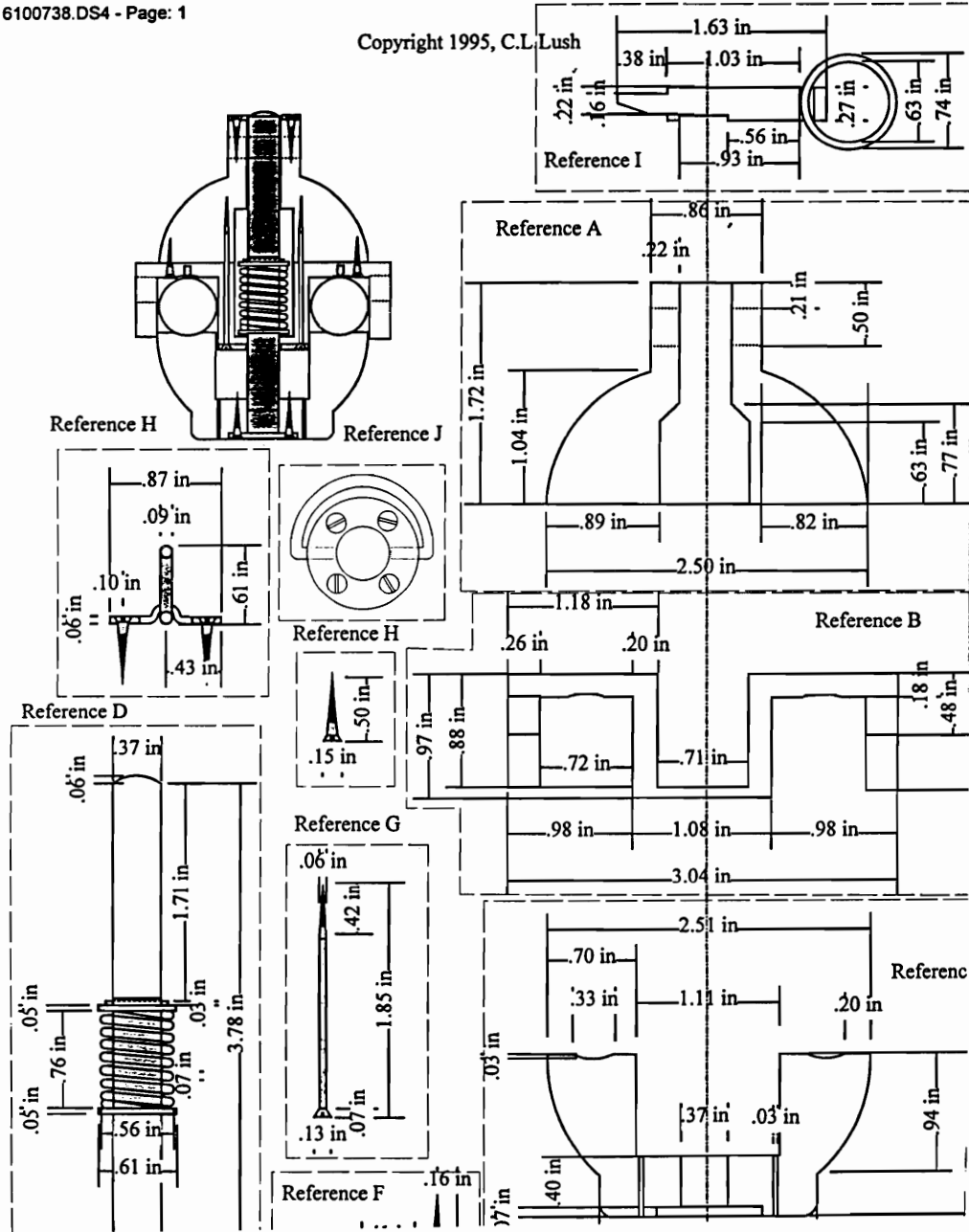




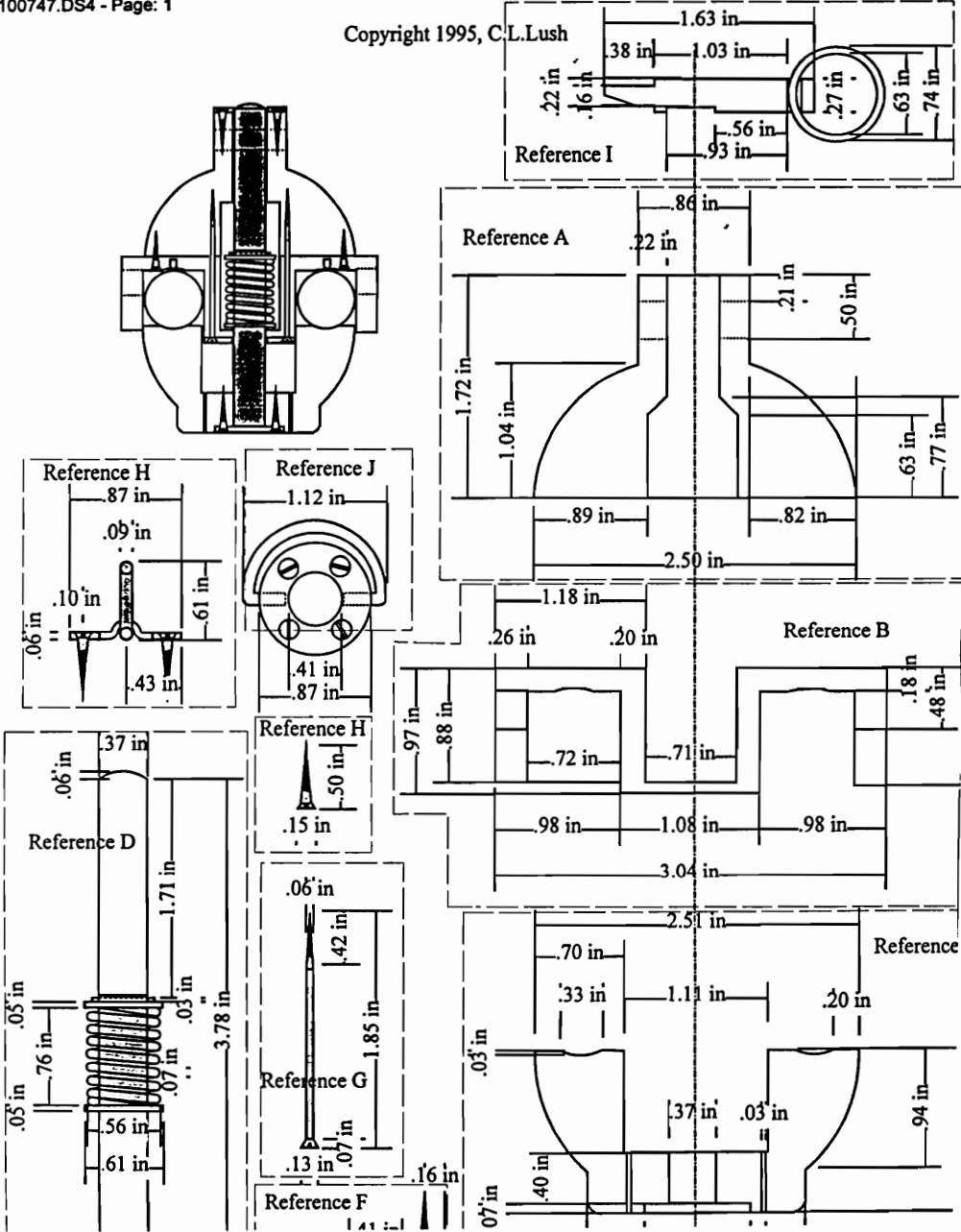


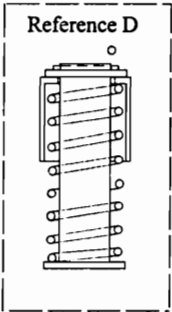
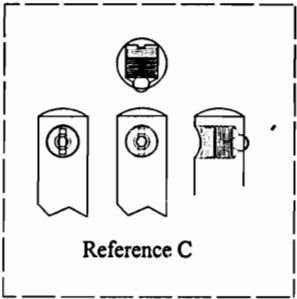
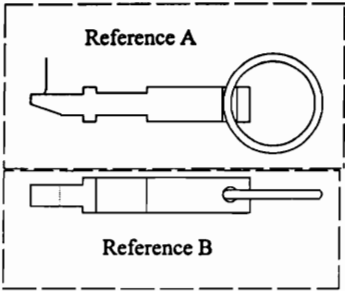


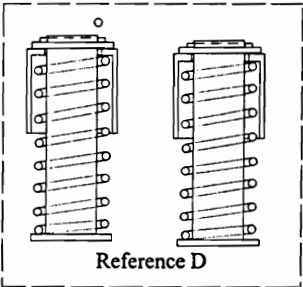
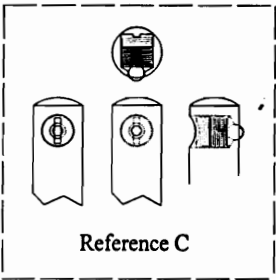
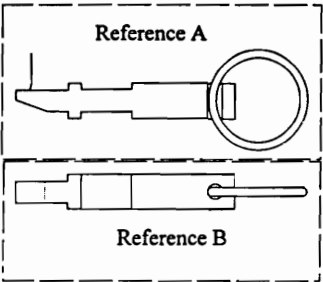
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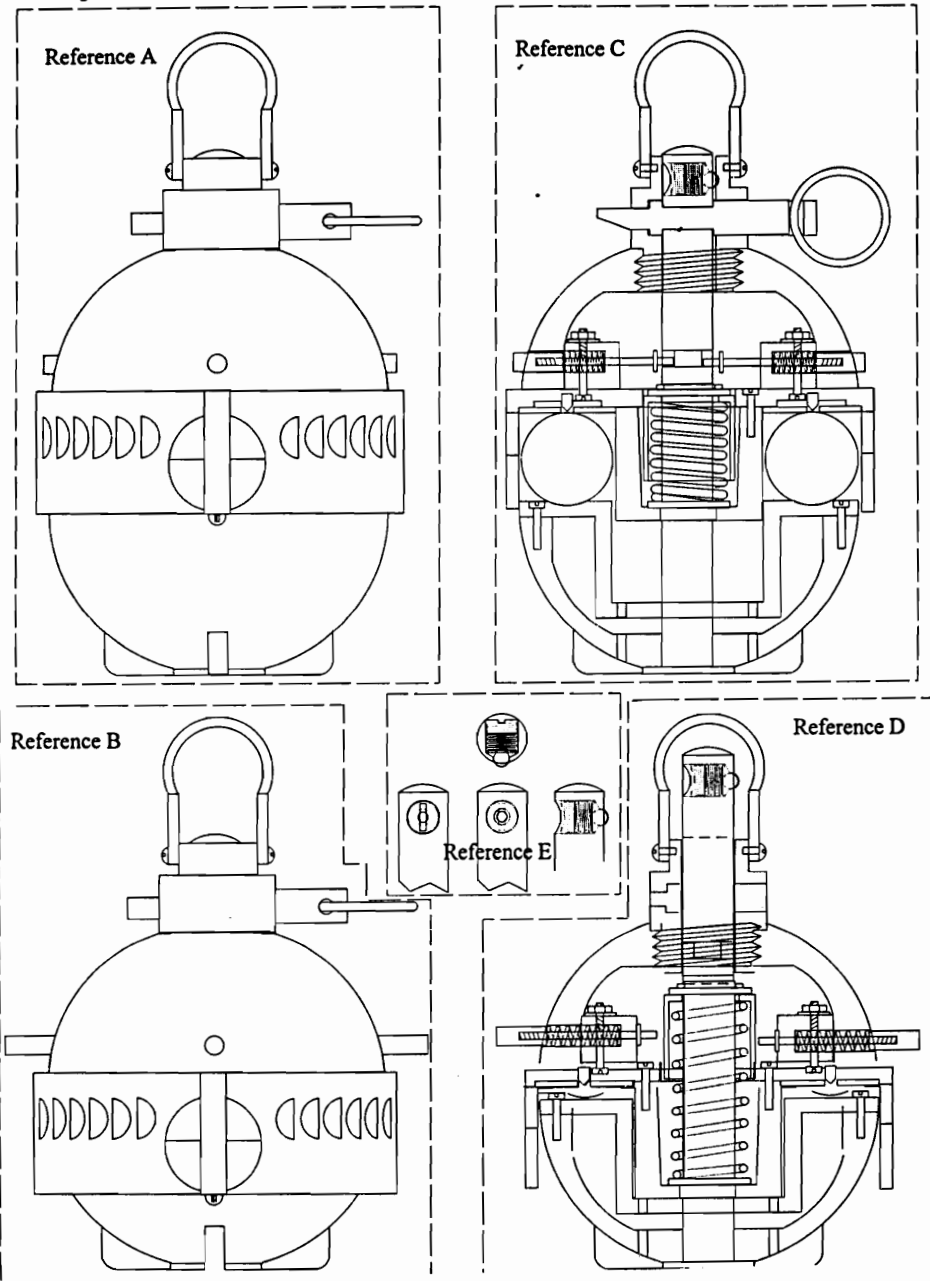


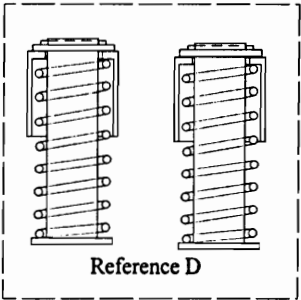
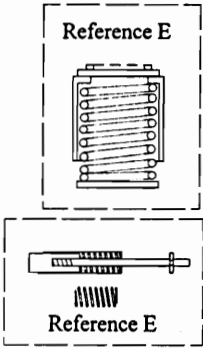
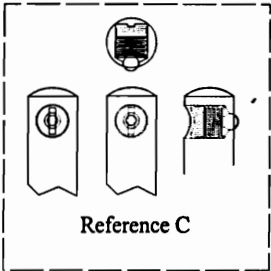
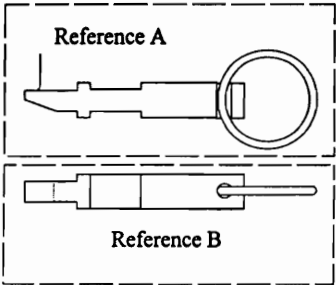
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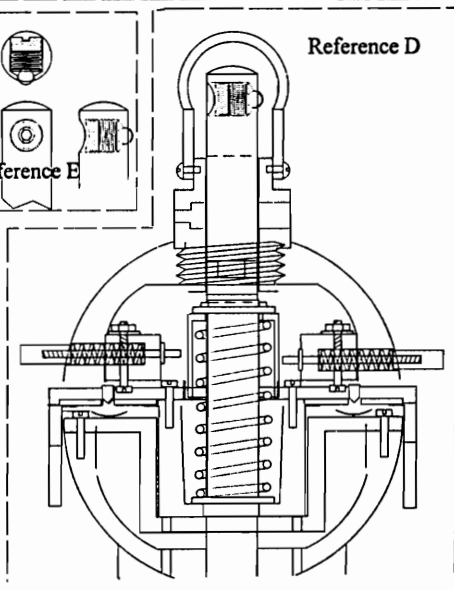
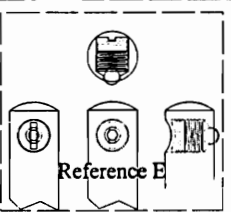
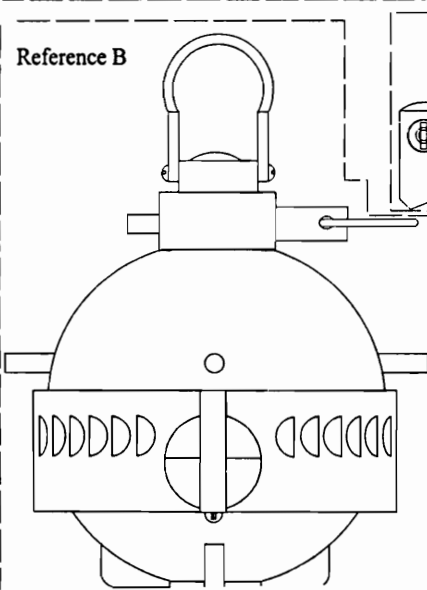
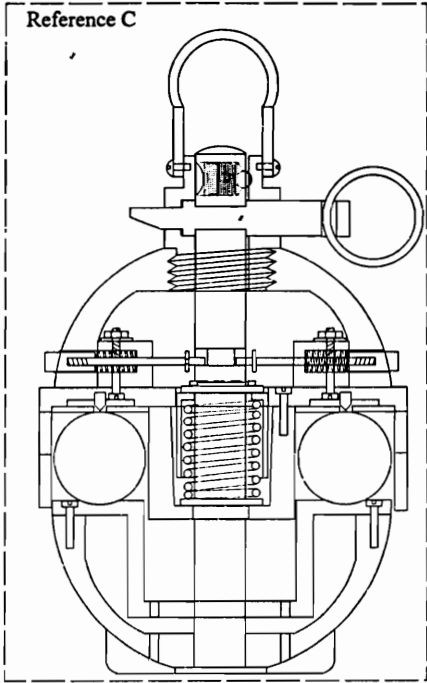
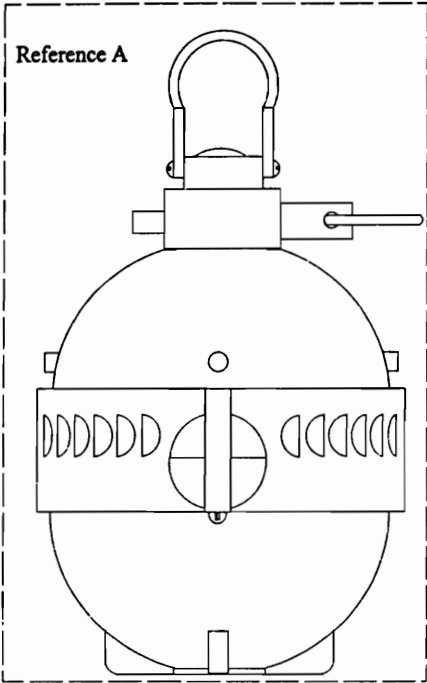


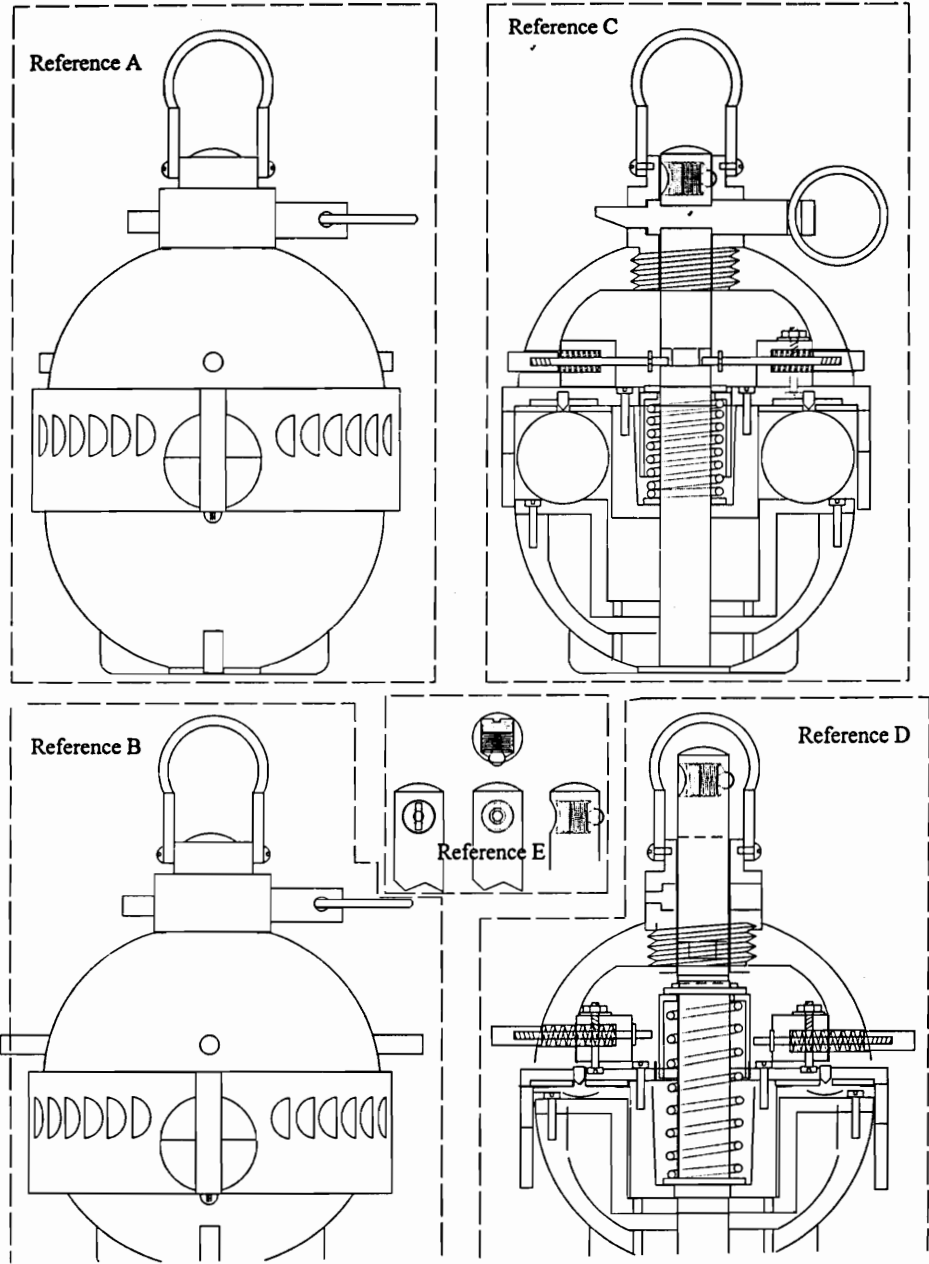


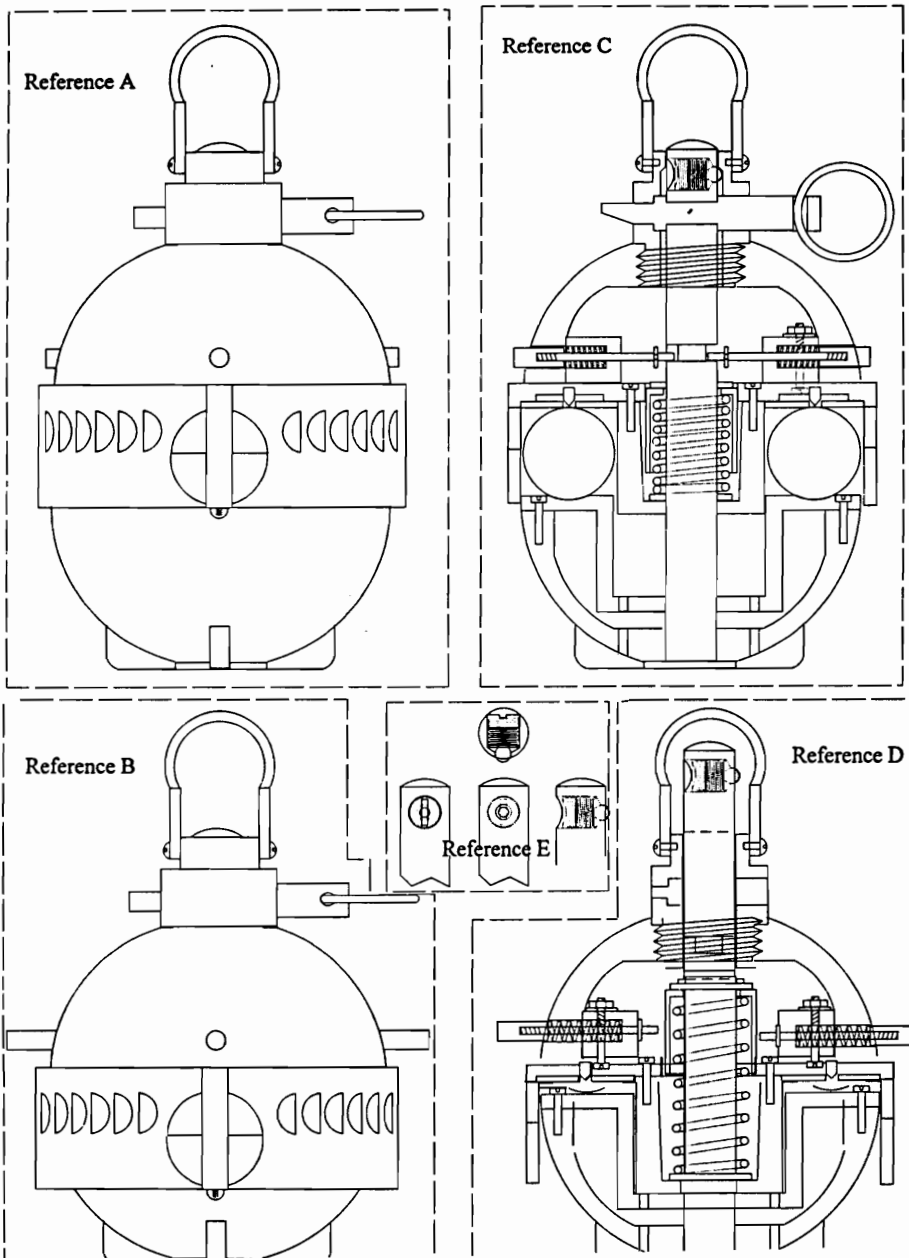


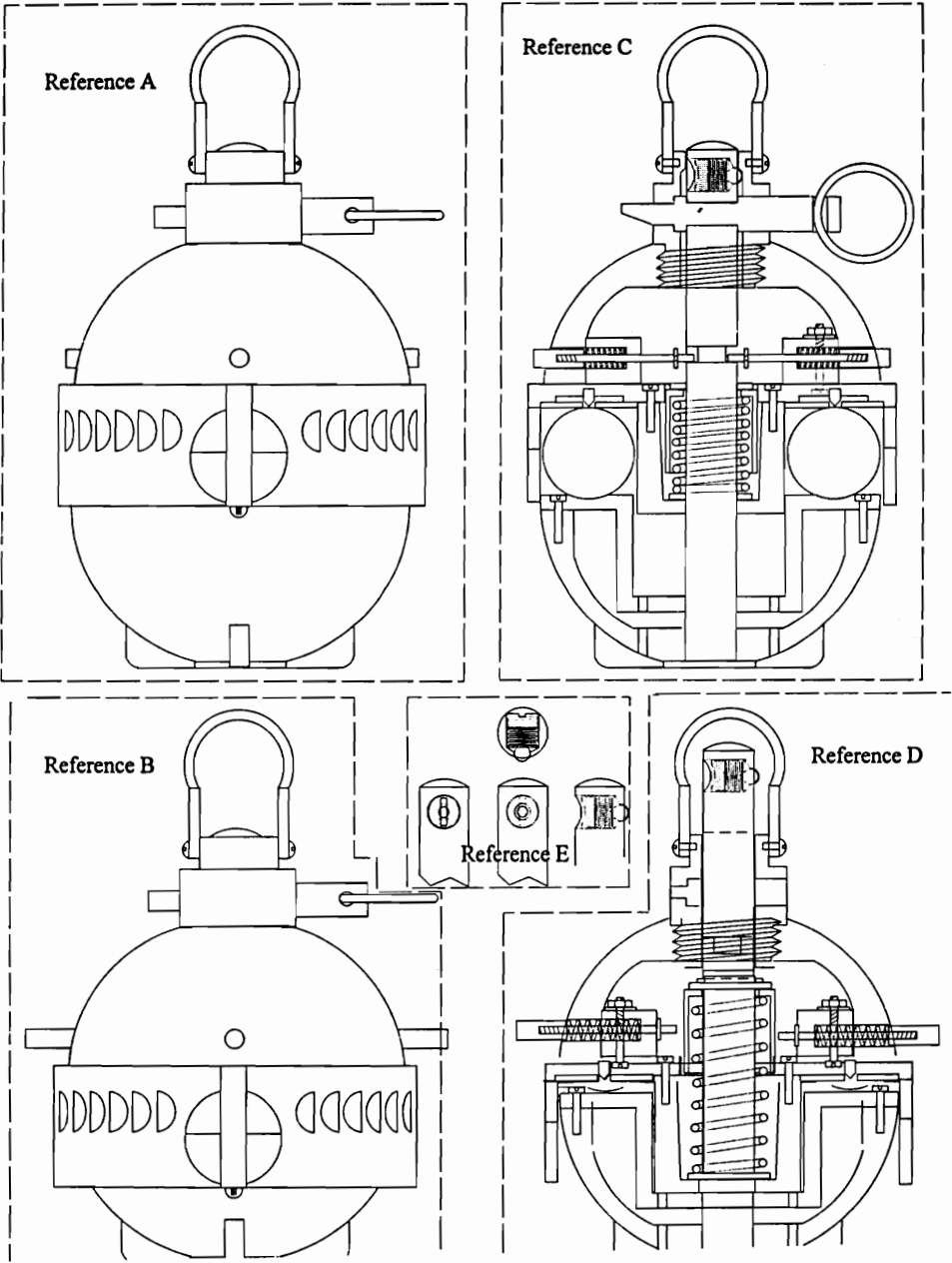


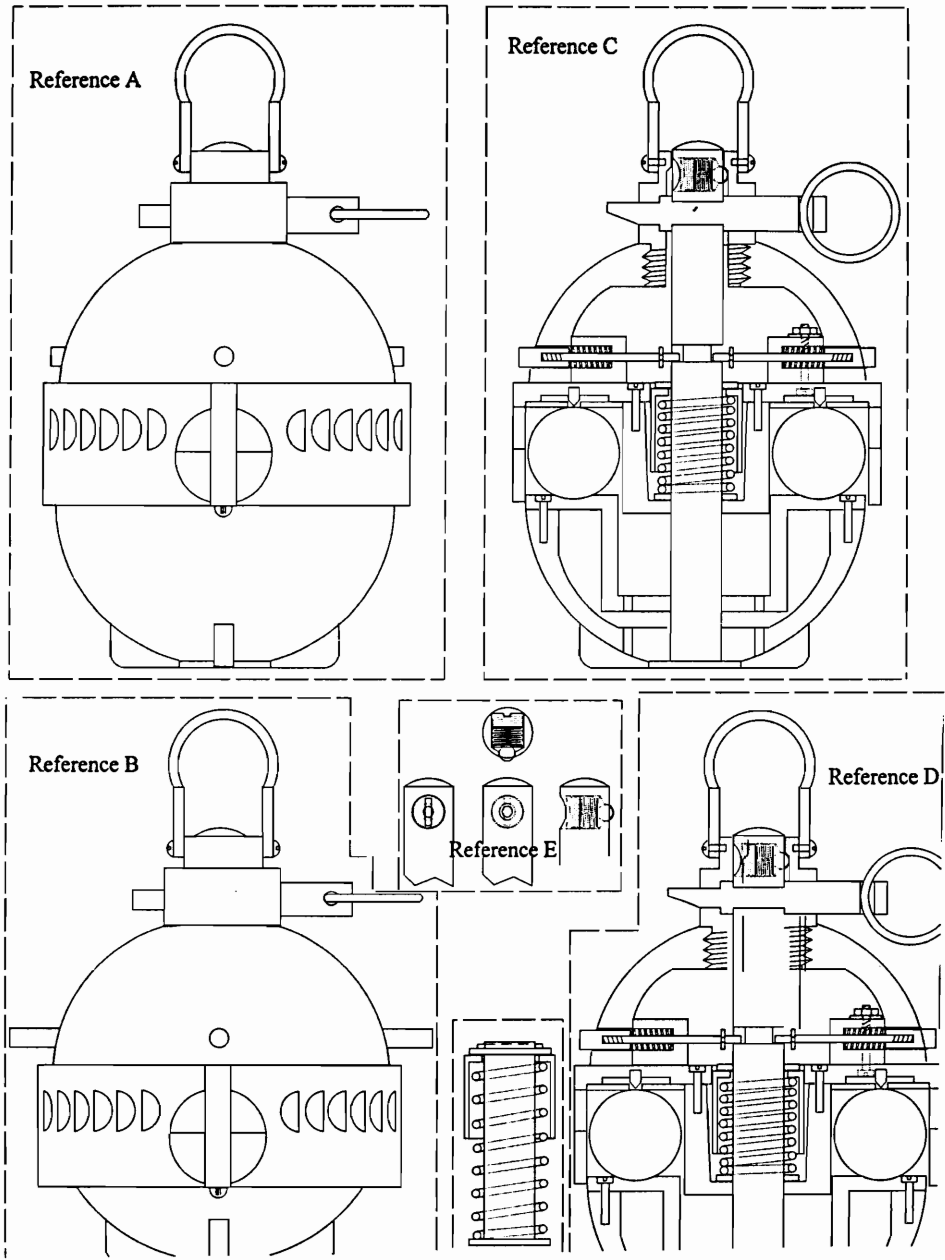


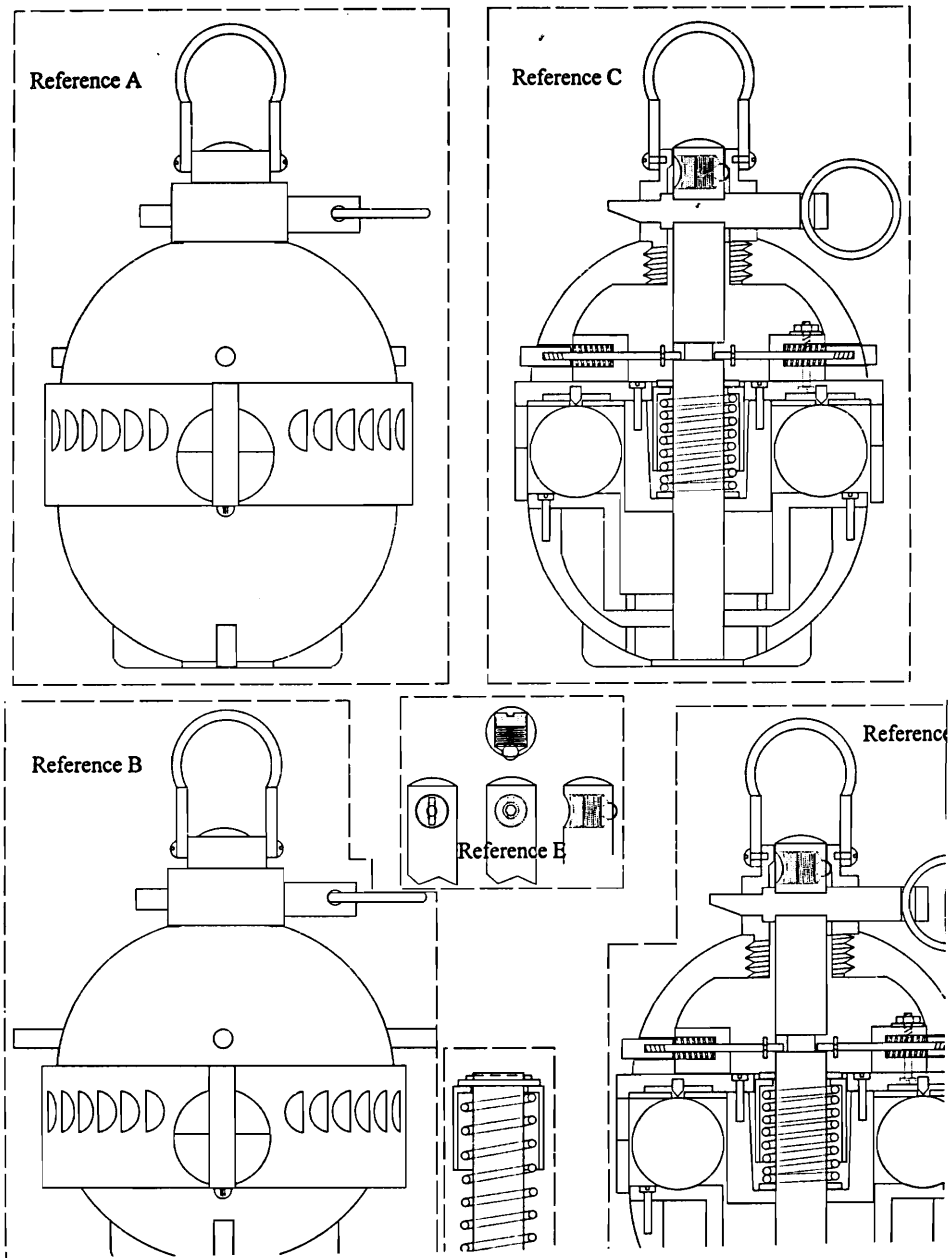


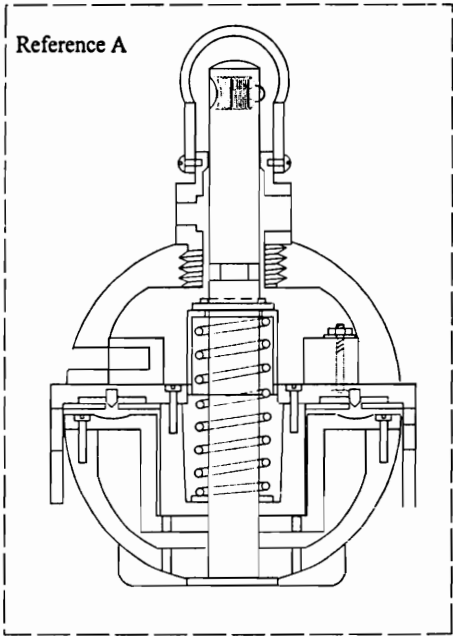


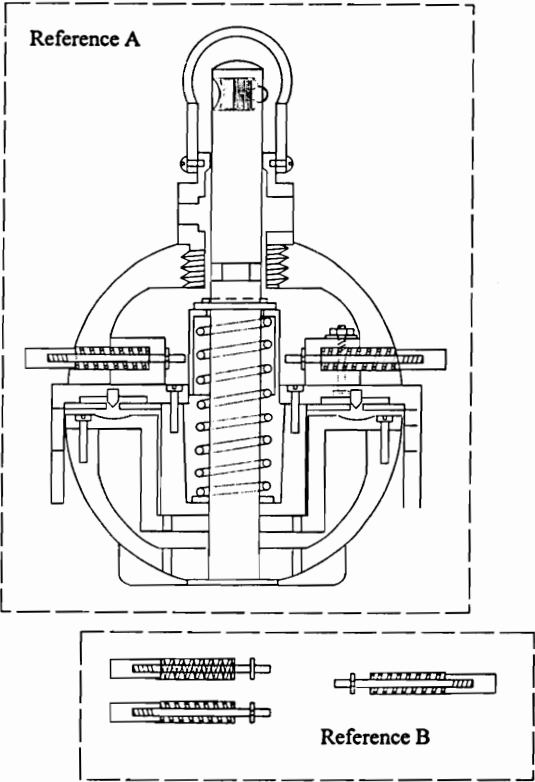


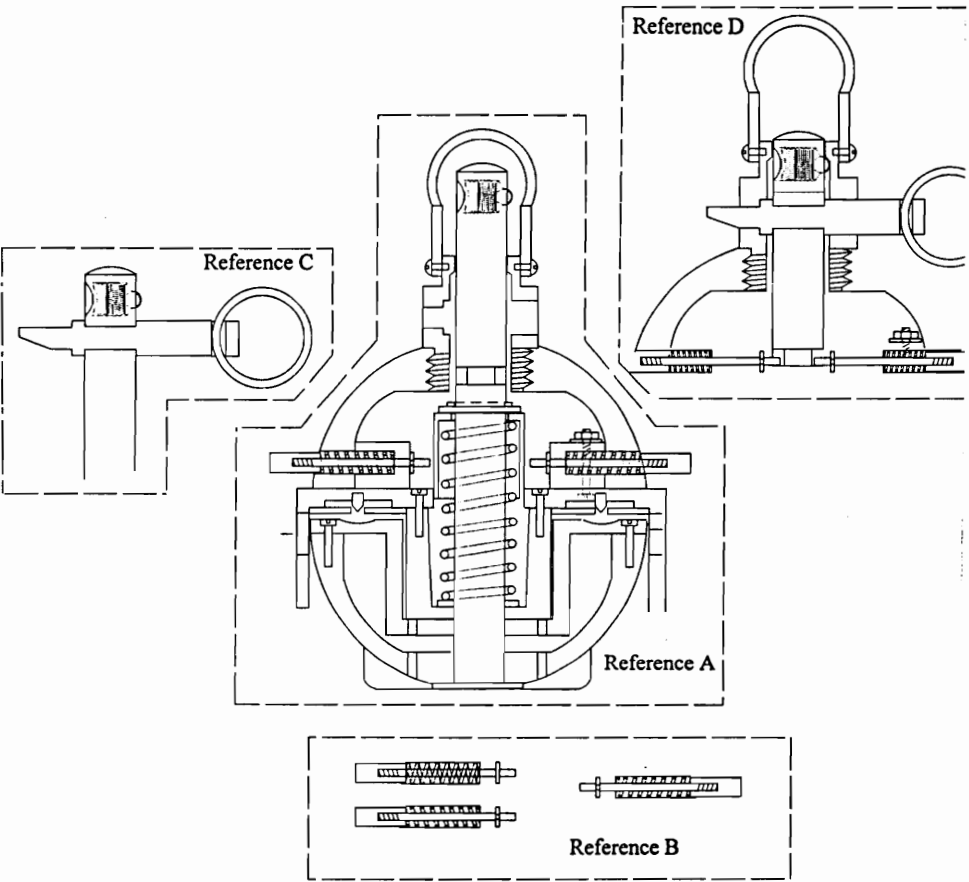


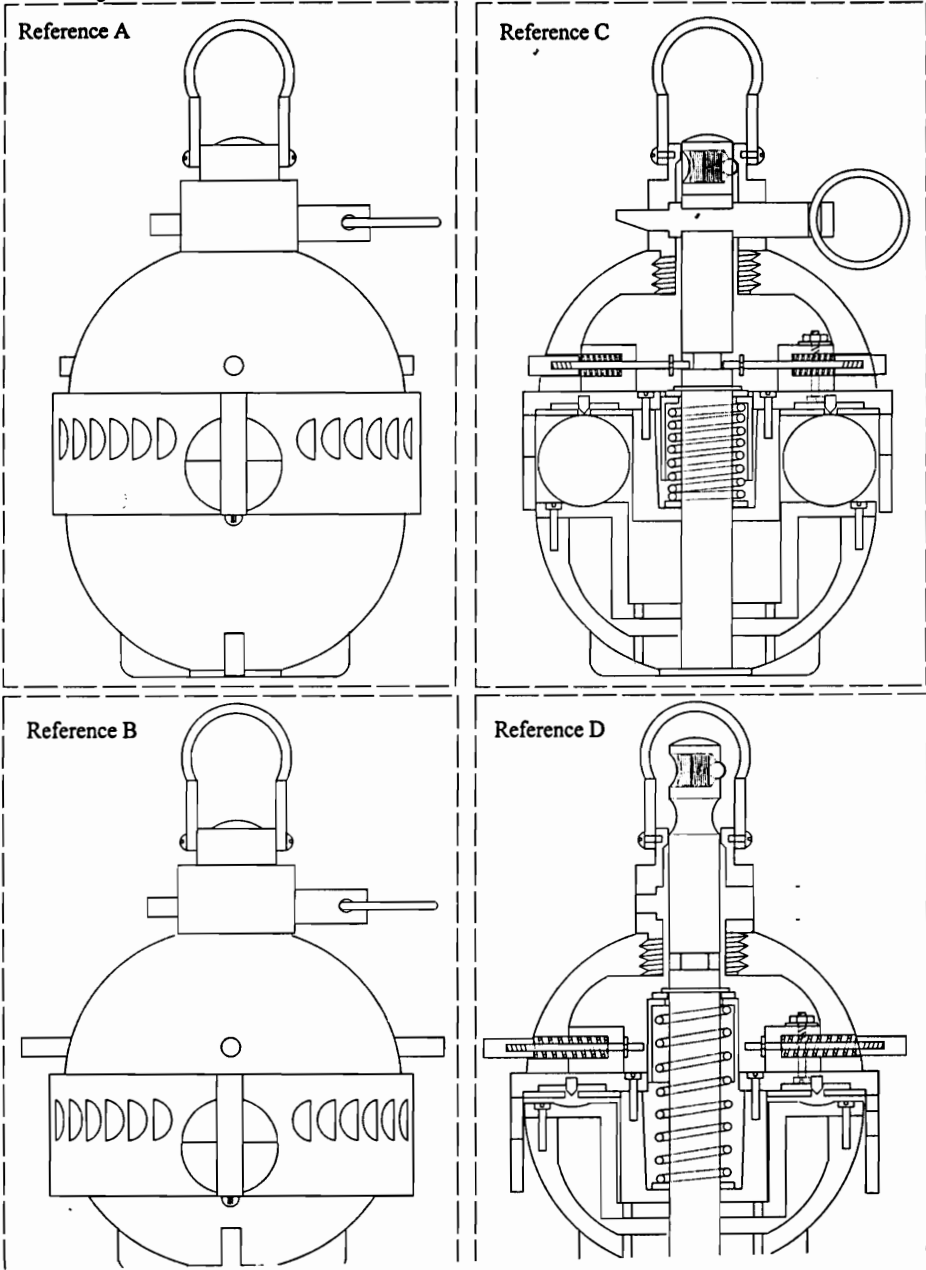


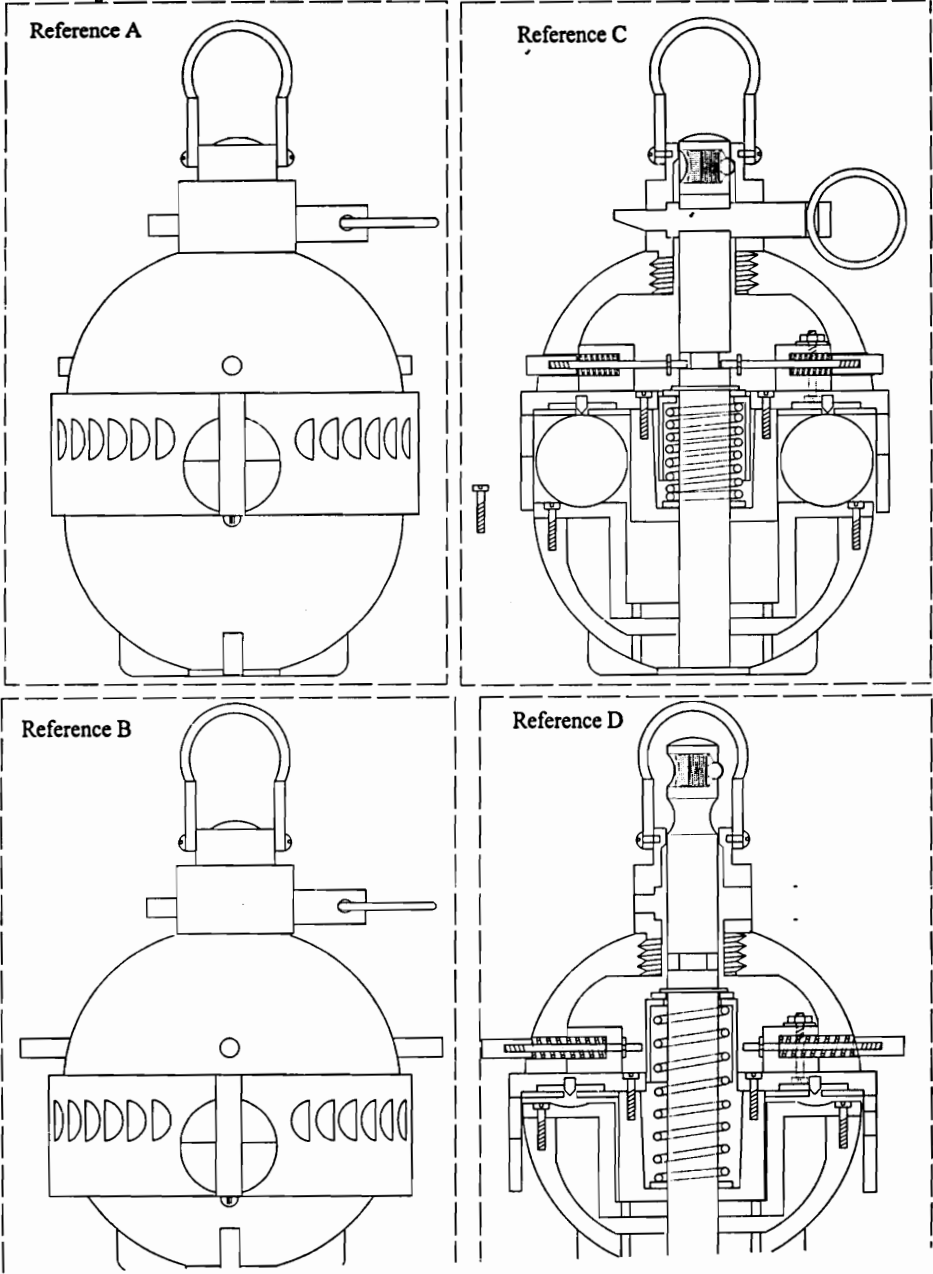


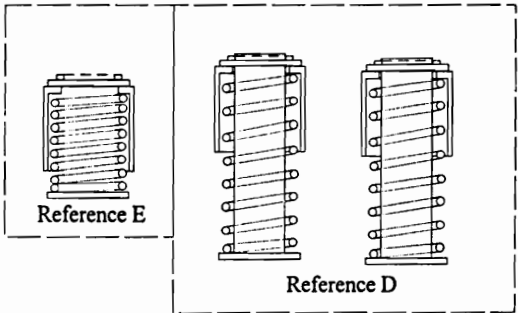
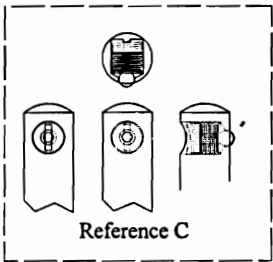
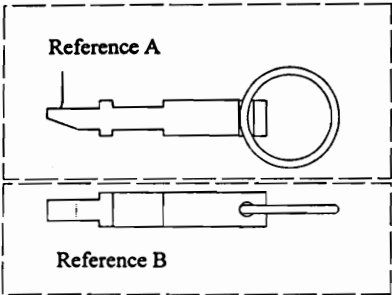


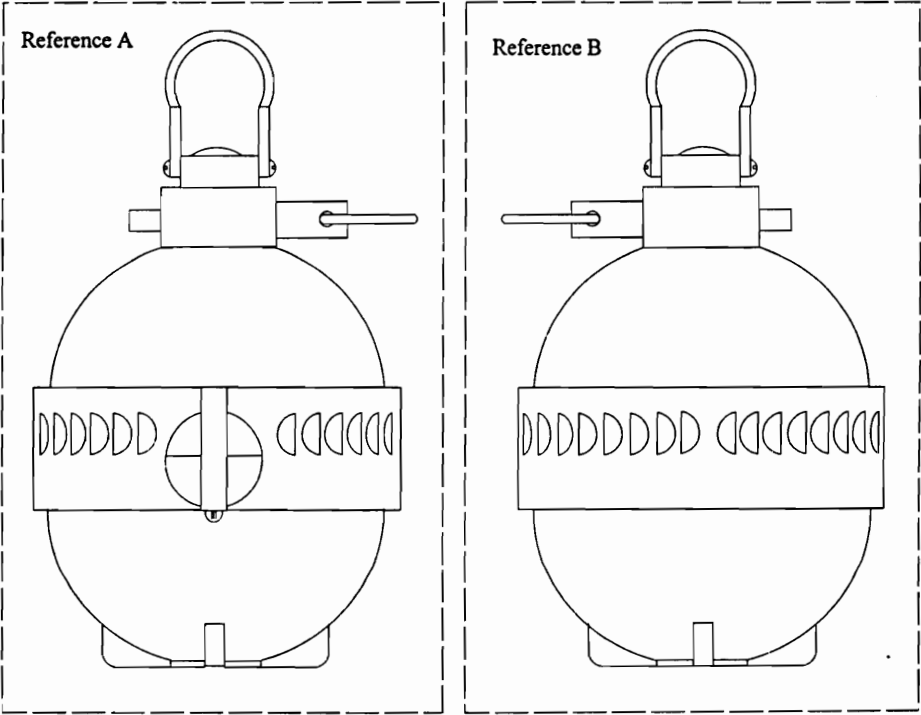


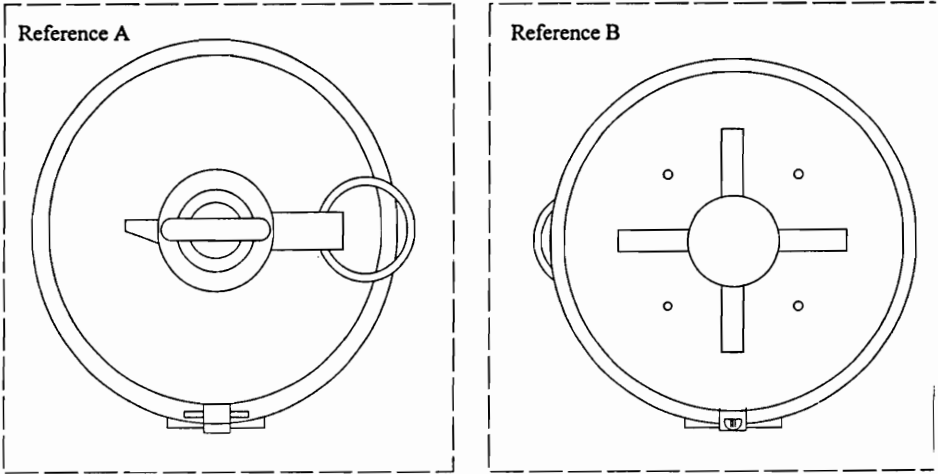


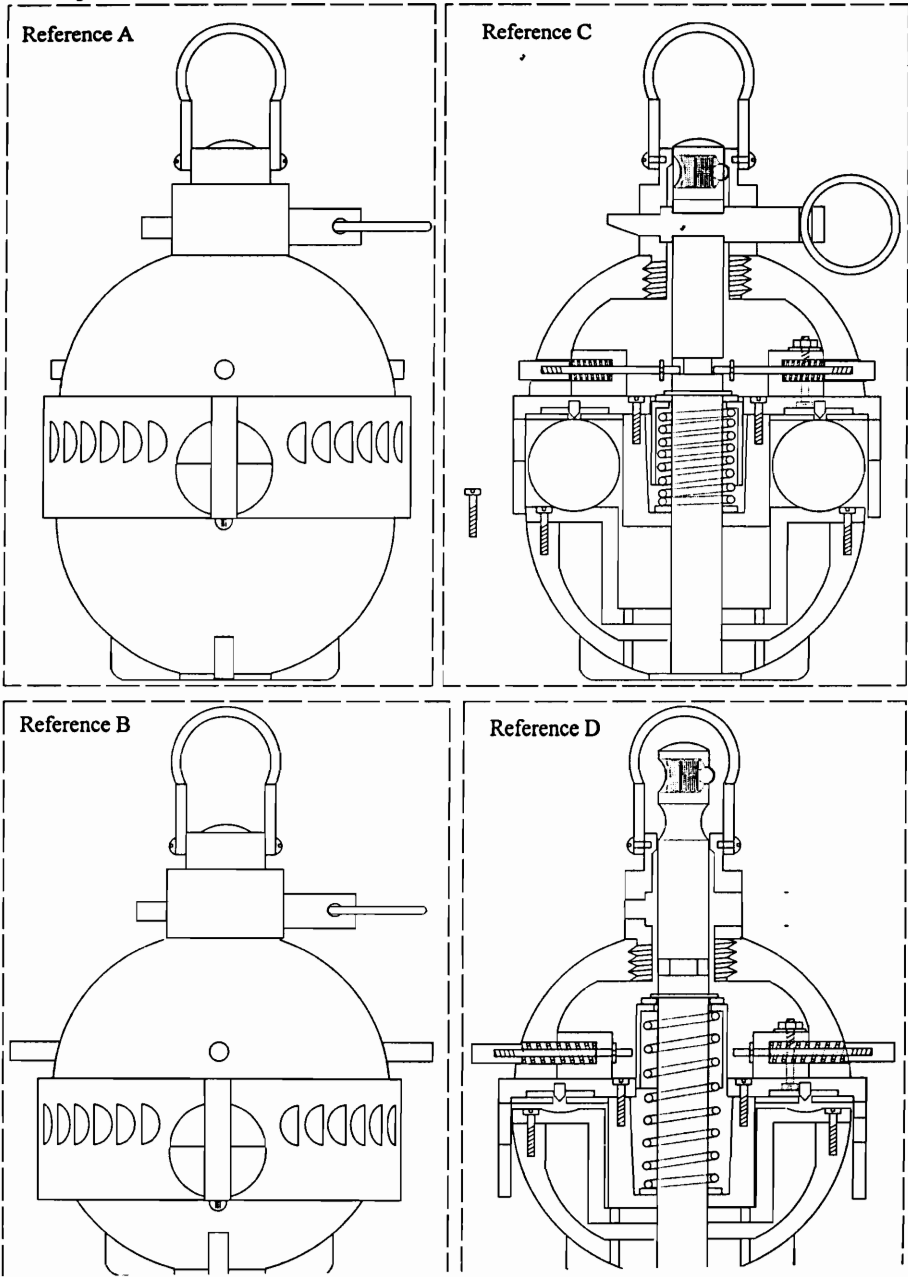








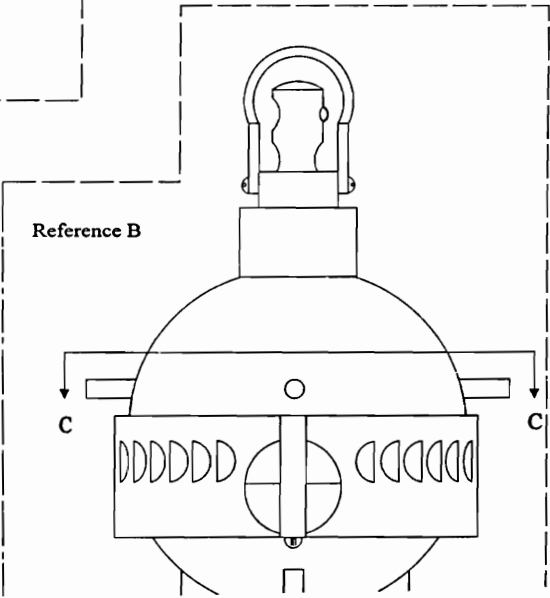
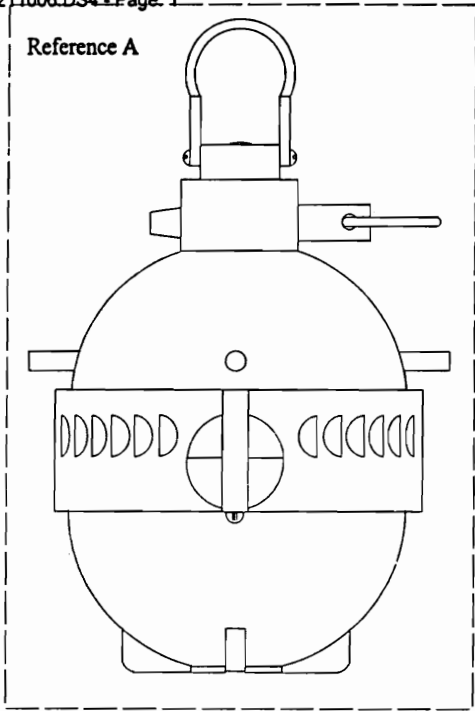




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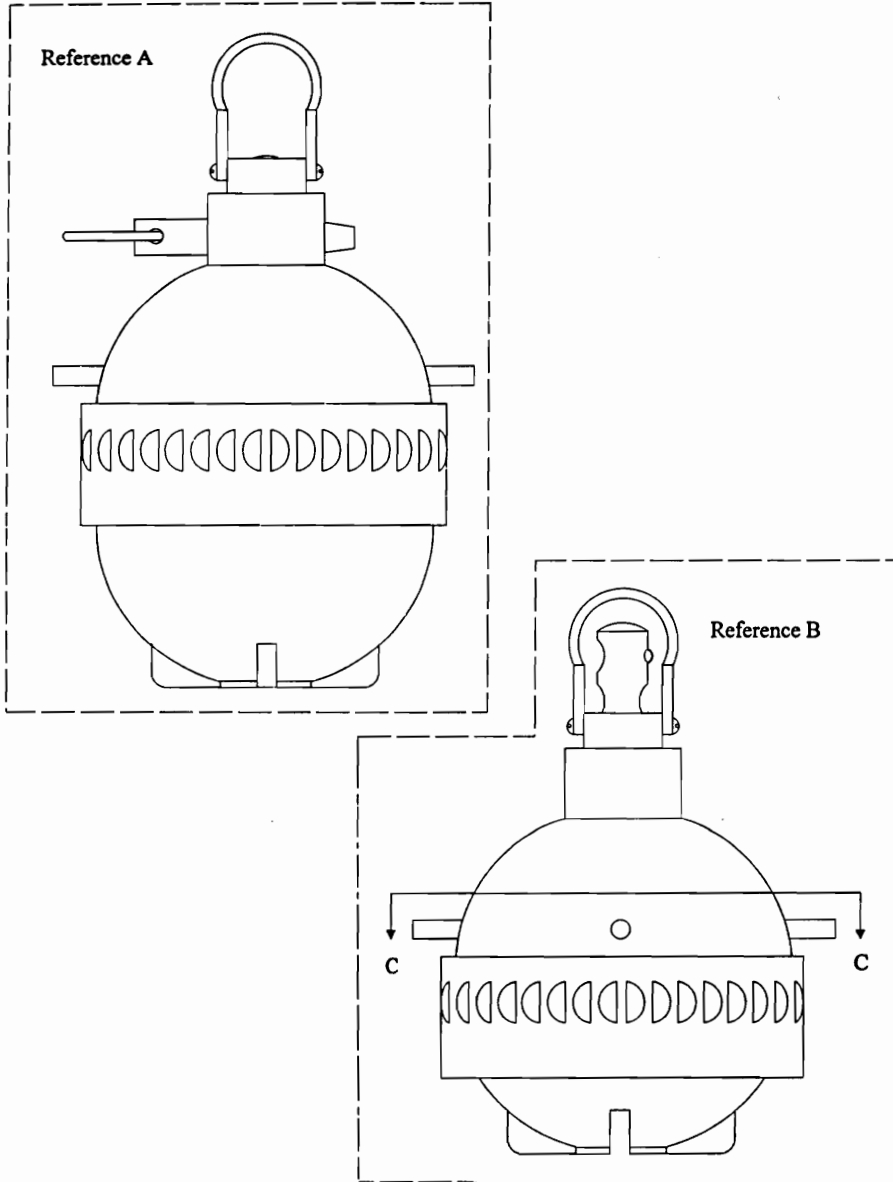
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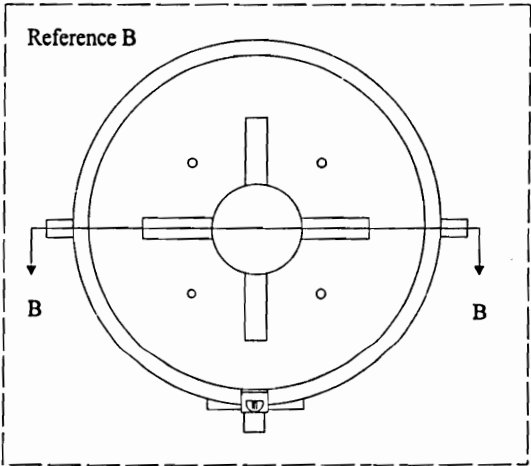
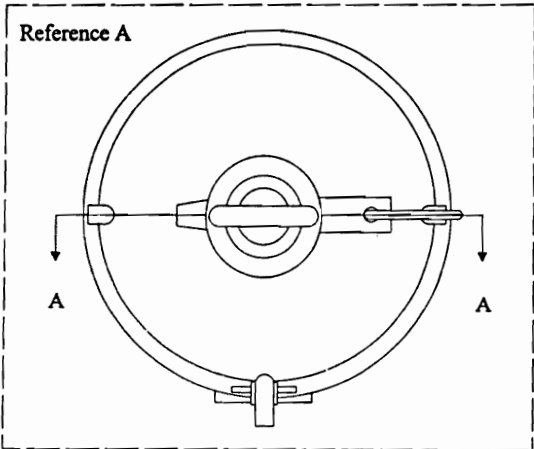
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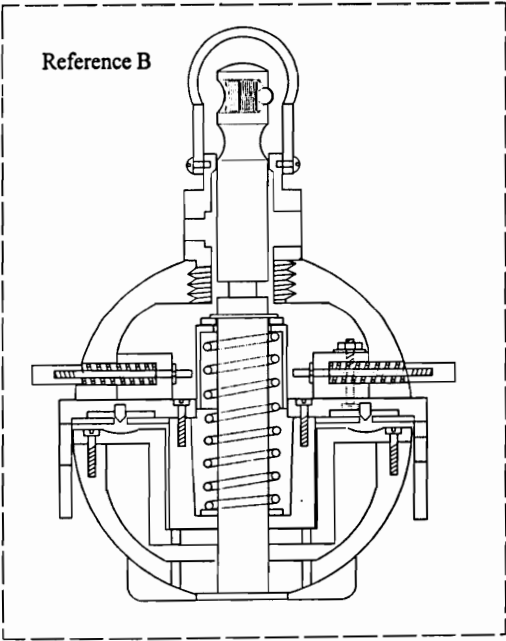
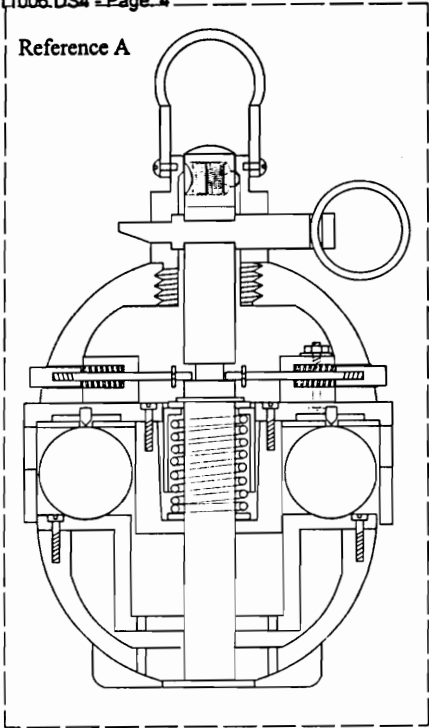
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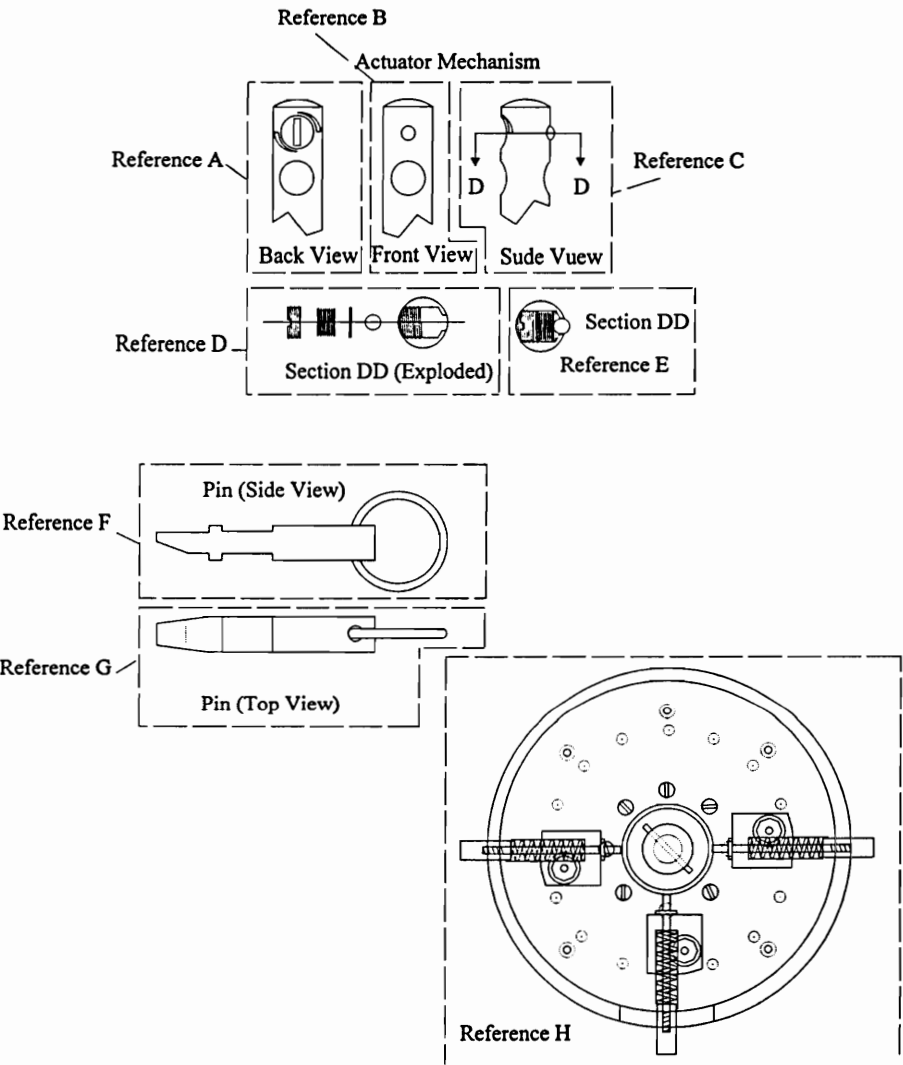
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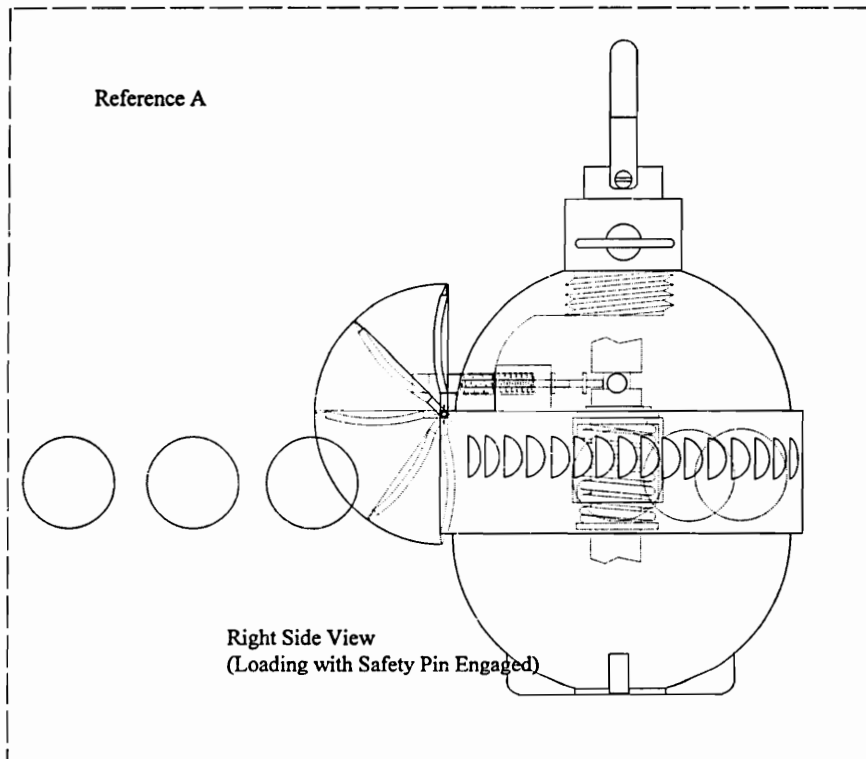
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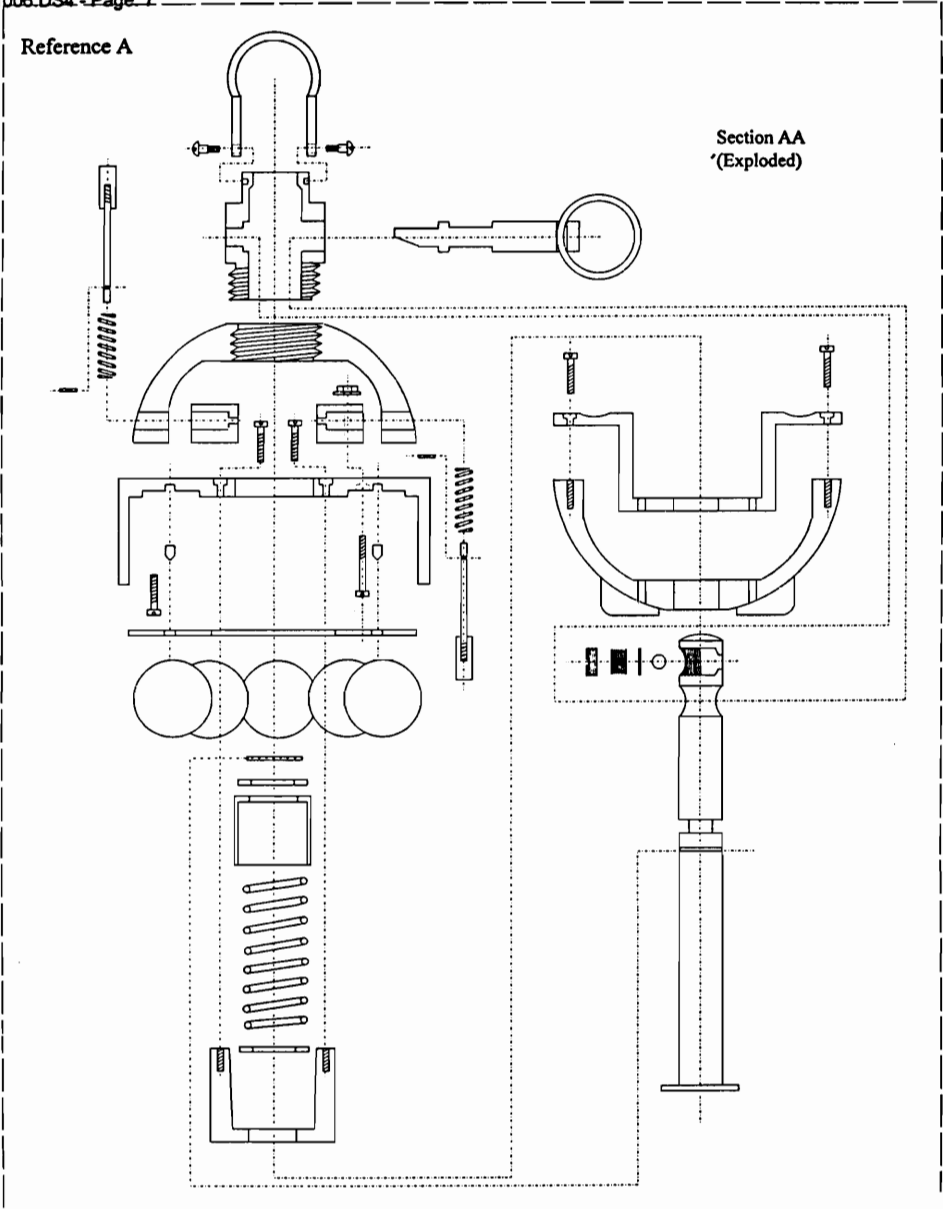
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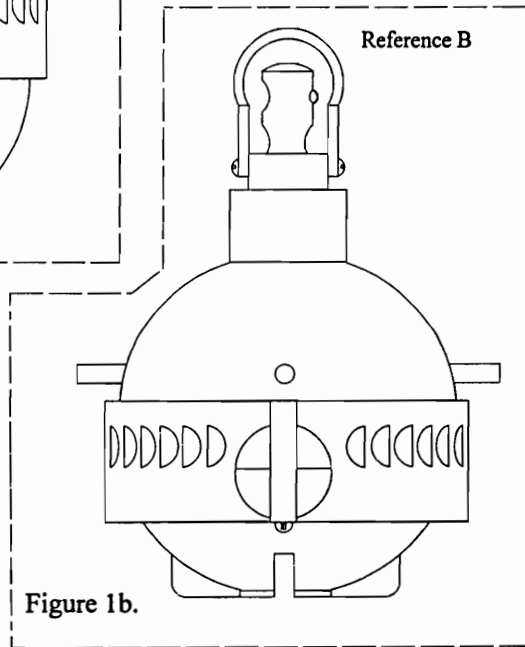
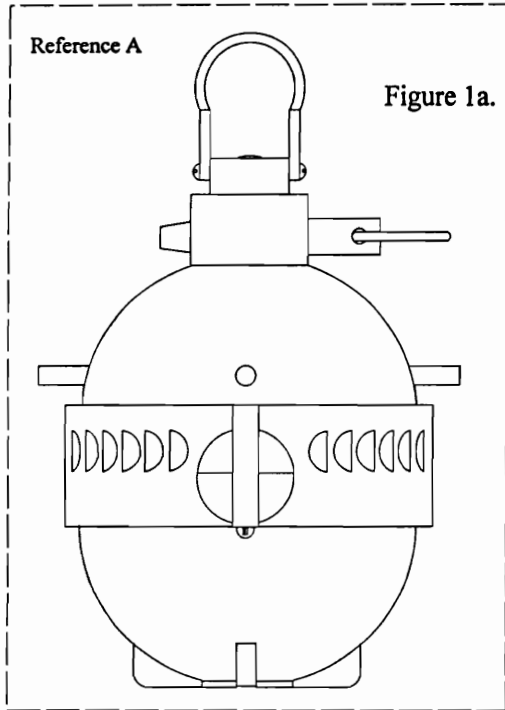


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7211145.DS4 - Page: 1

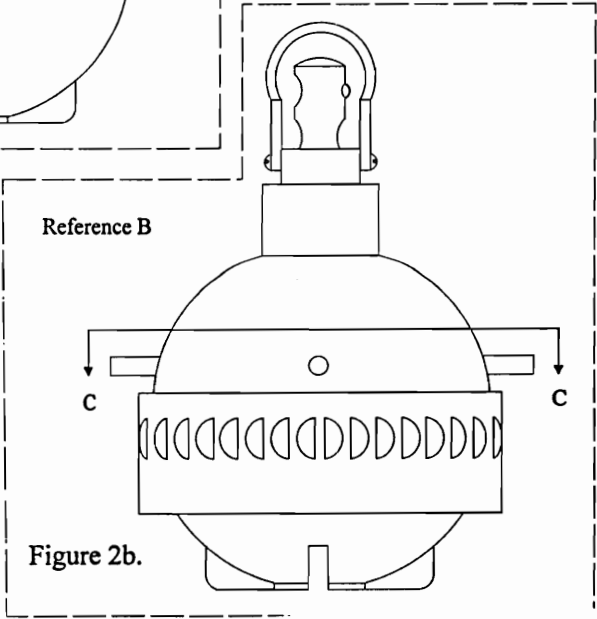
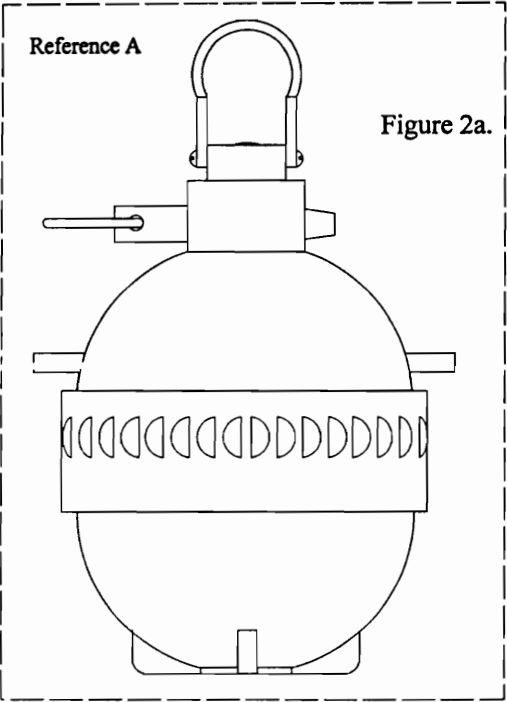
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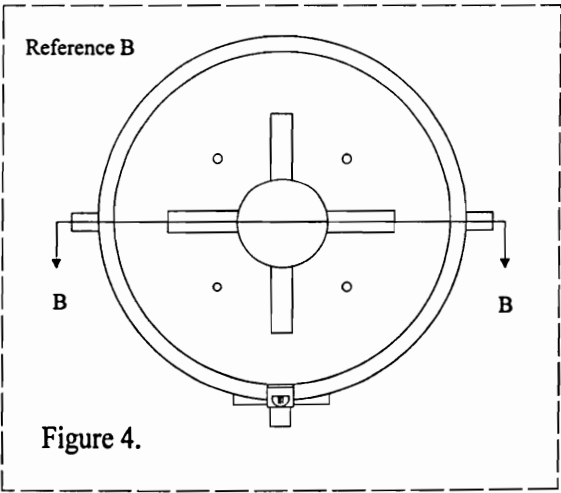
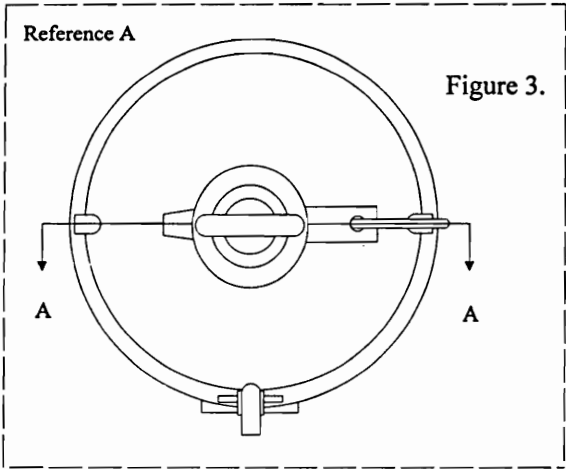
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7211145.DS4 - Page: 2

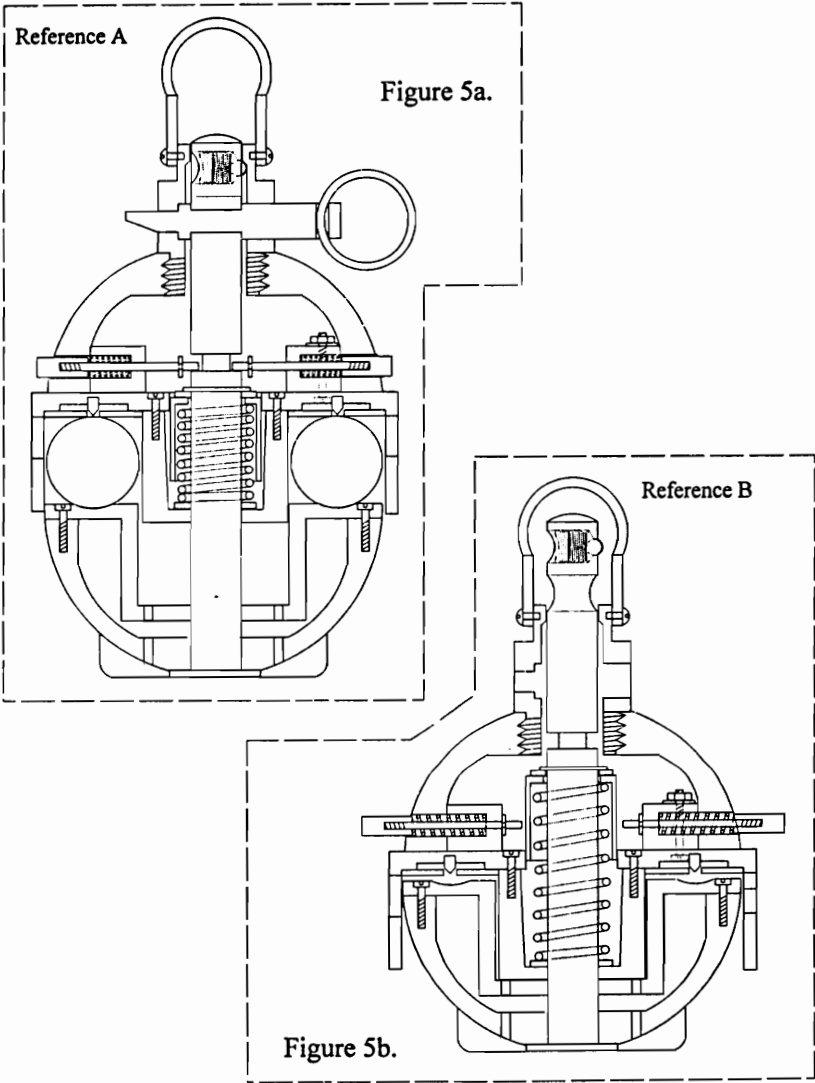
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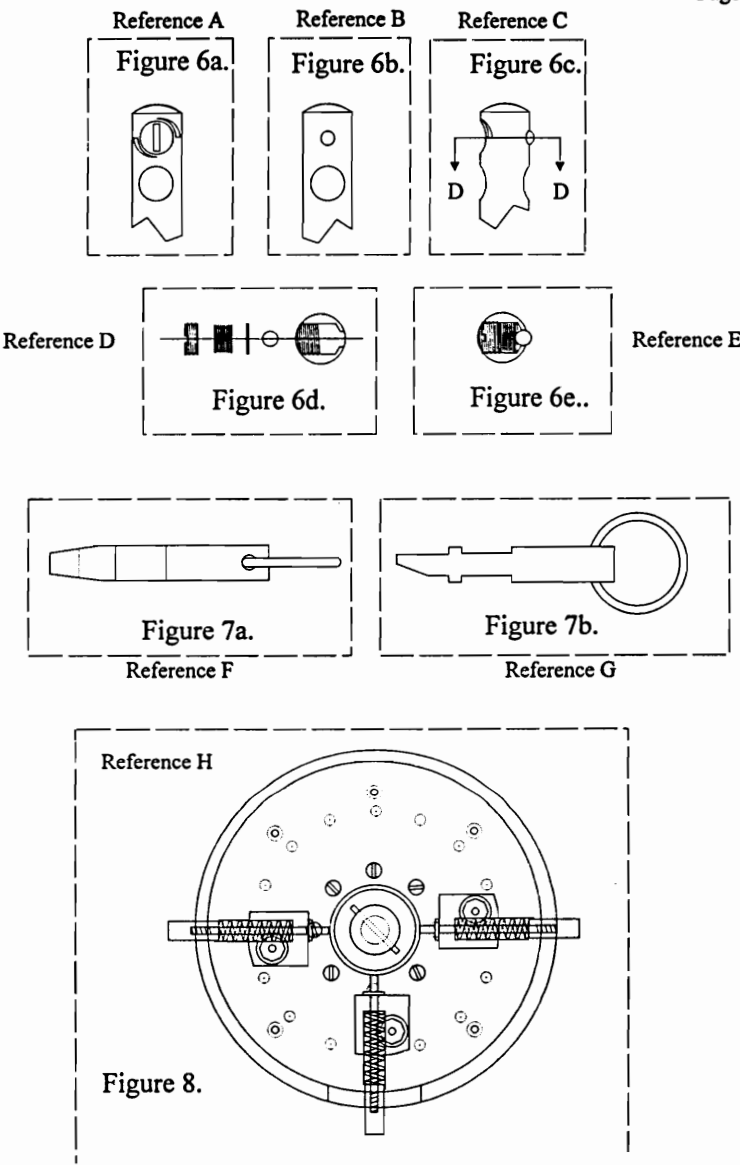
Reusable Paintball Grenade
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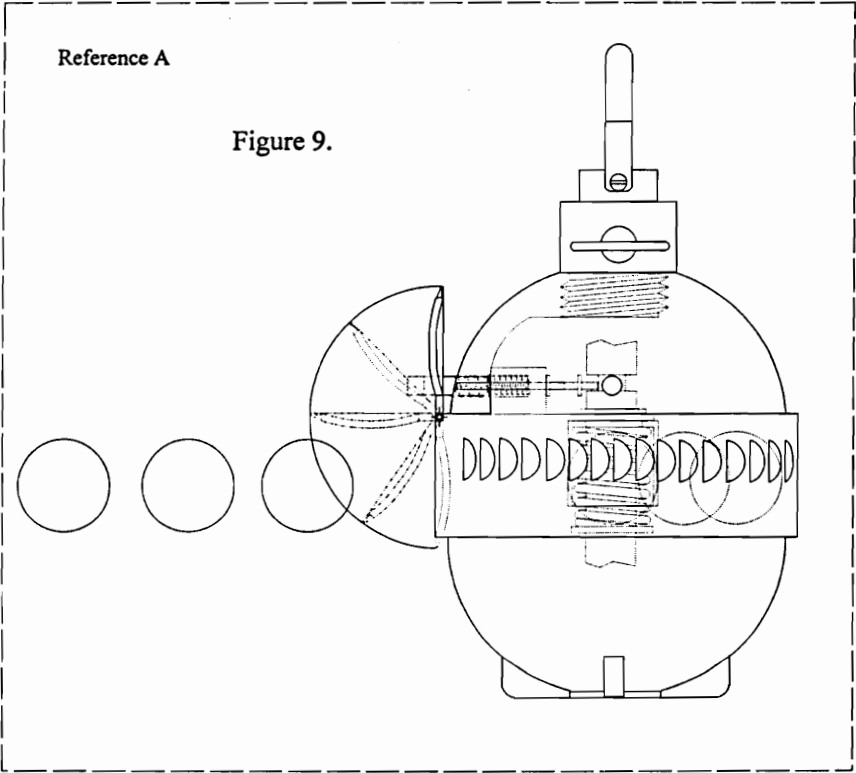
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Reference A

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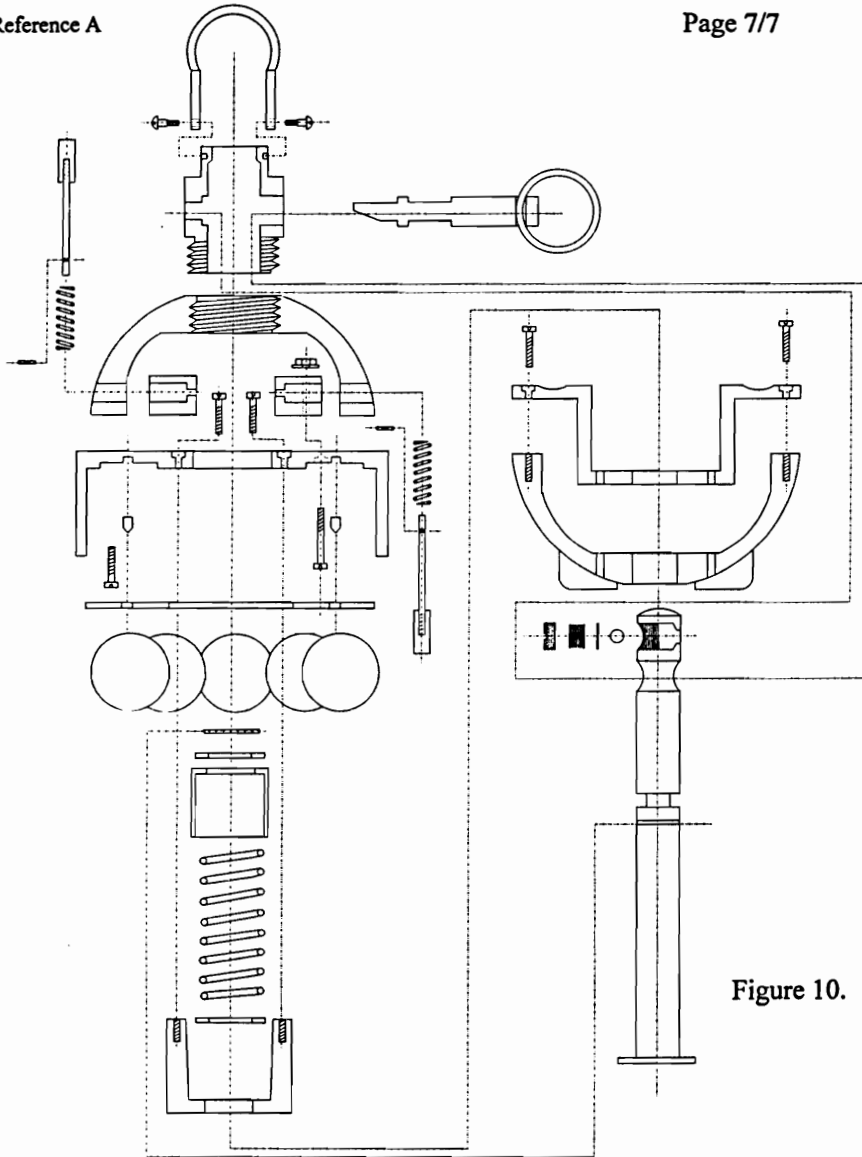
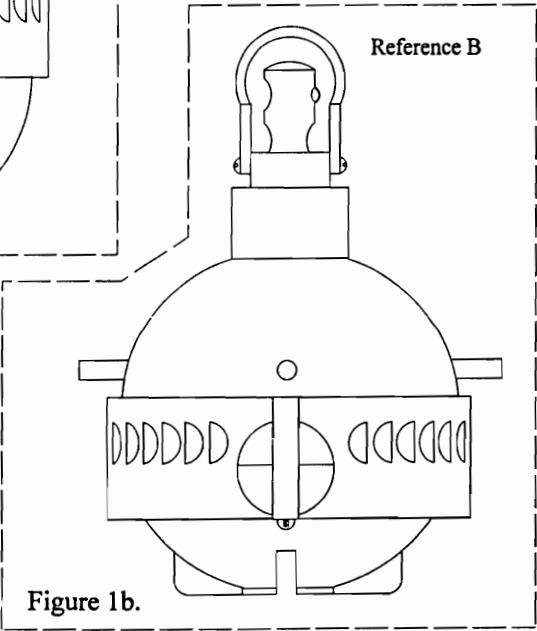
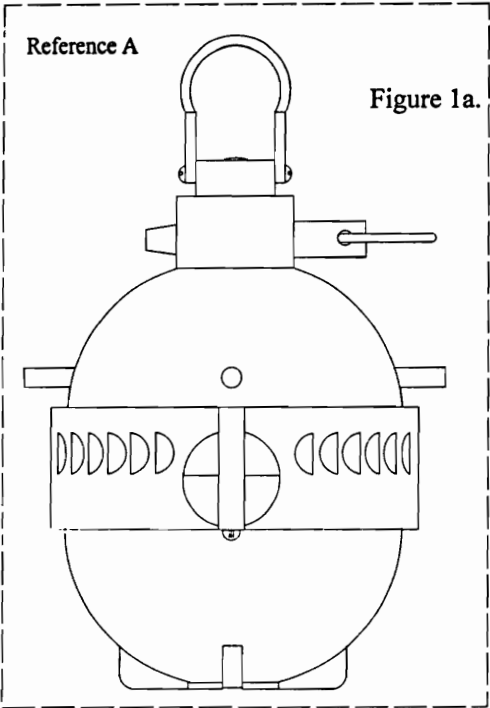


Figure 10.

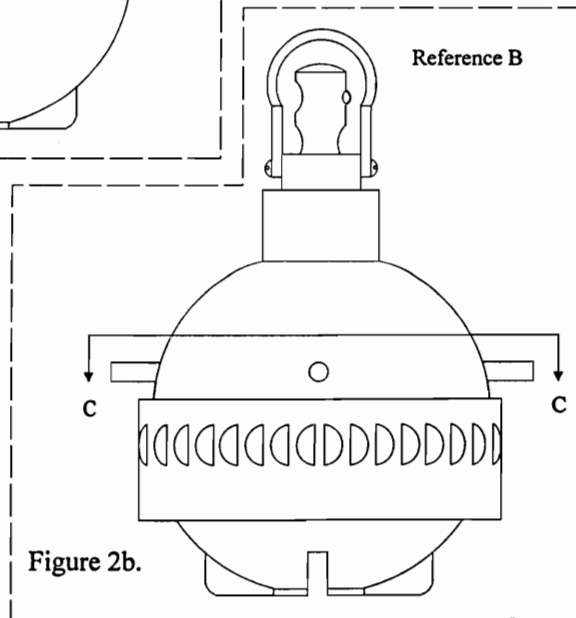
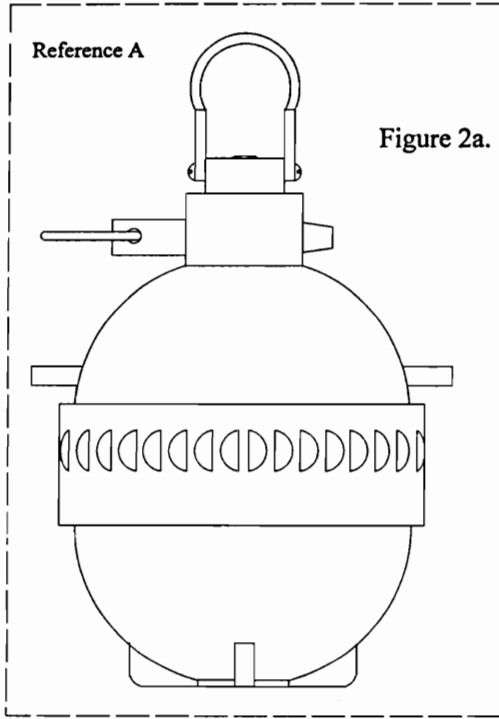
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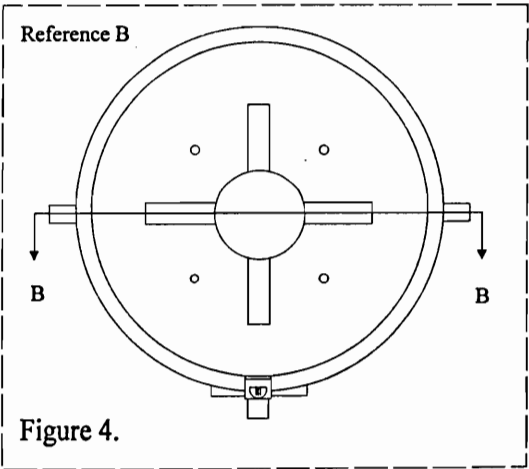
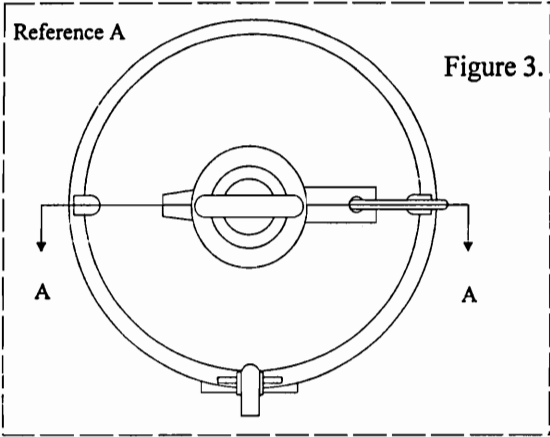
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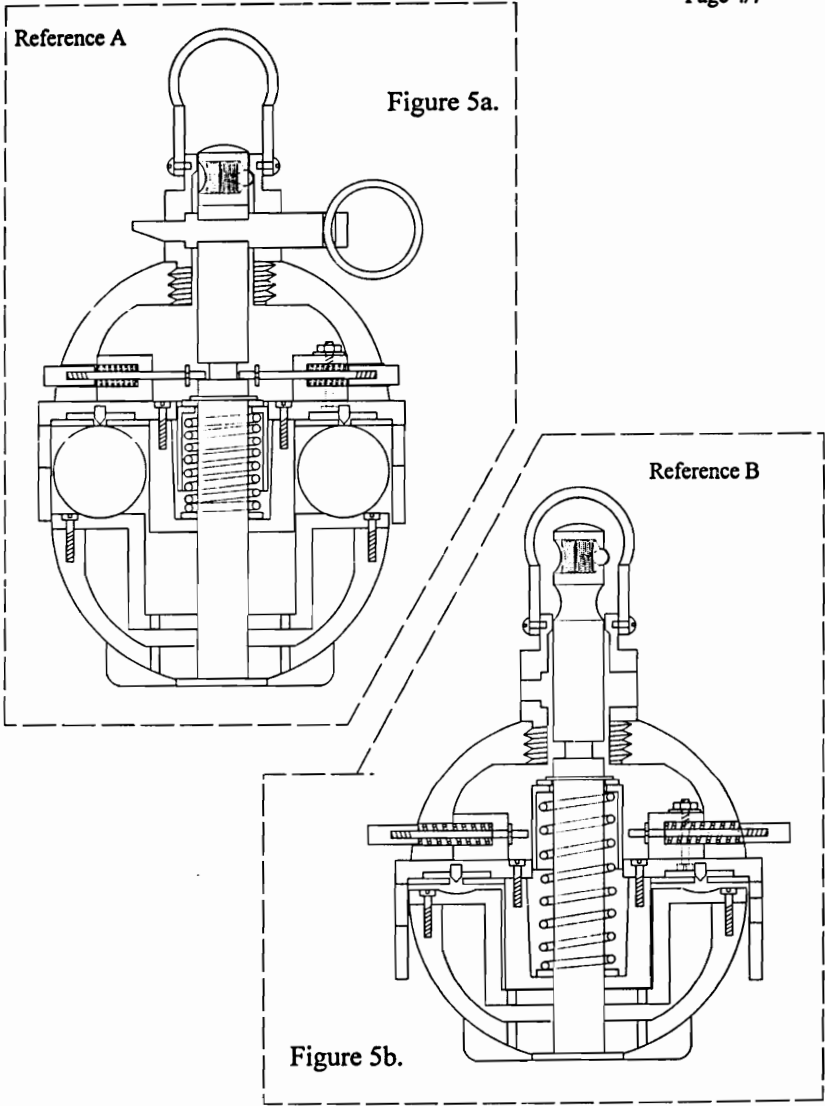
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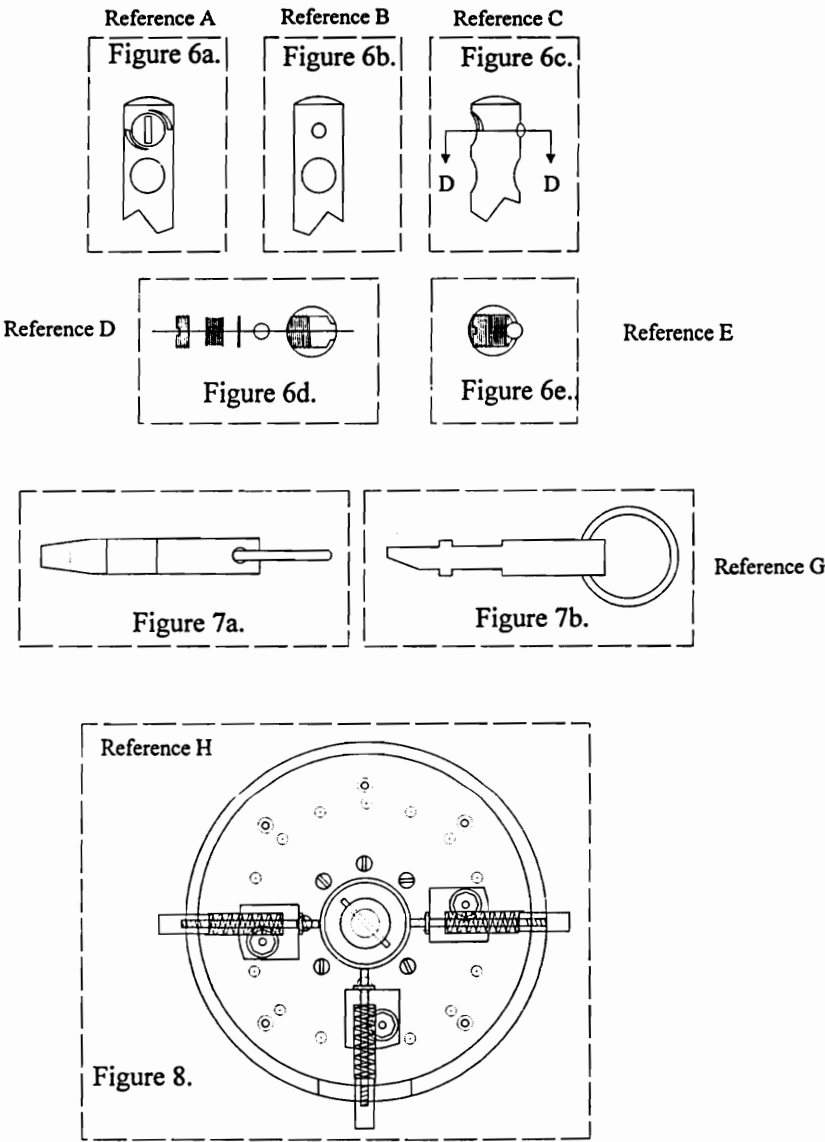


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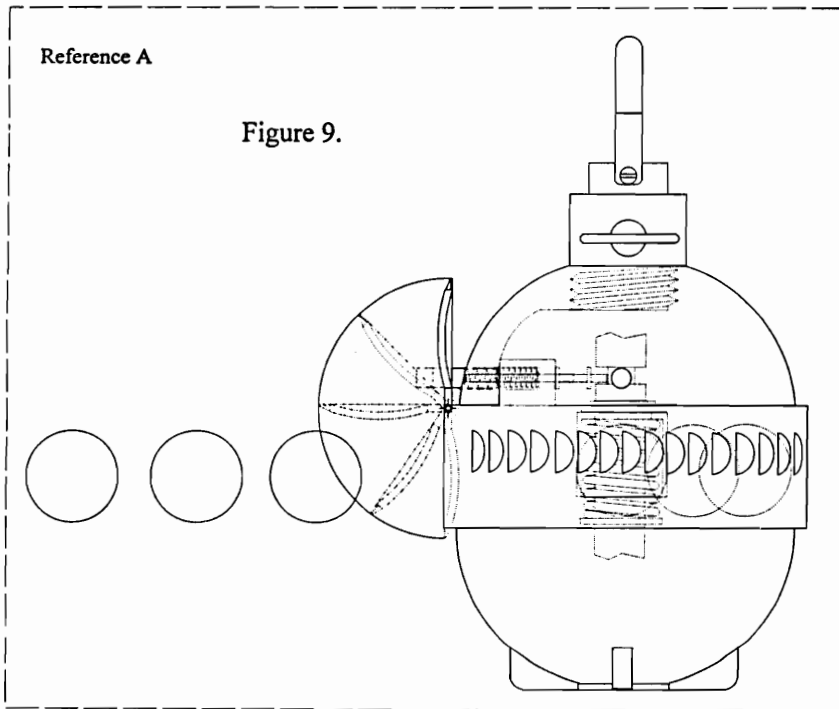


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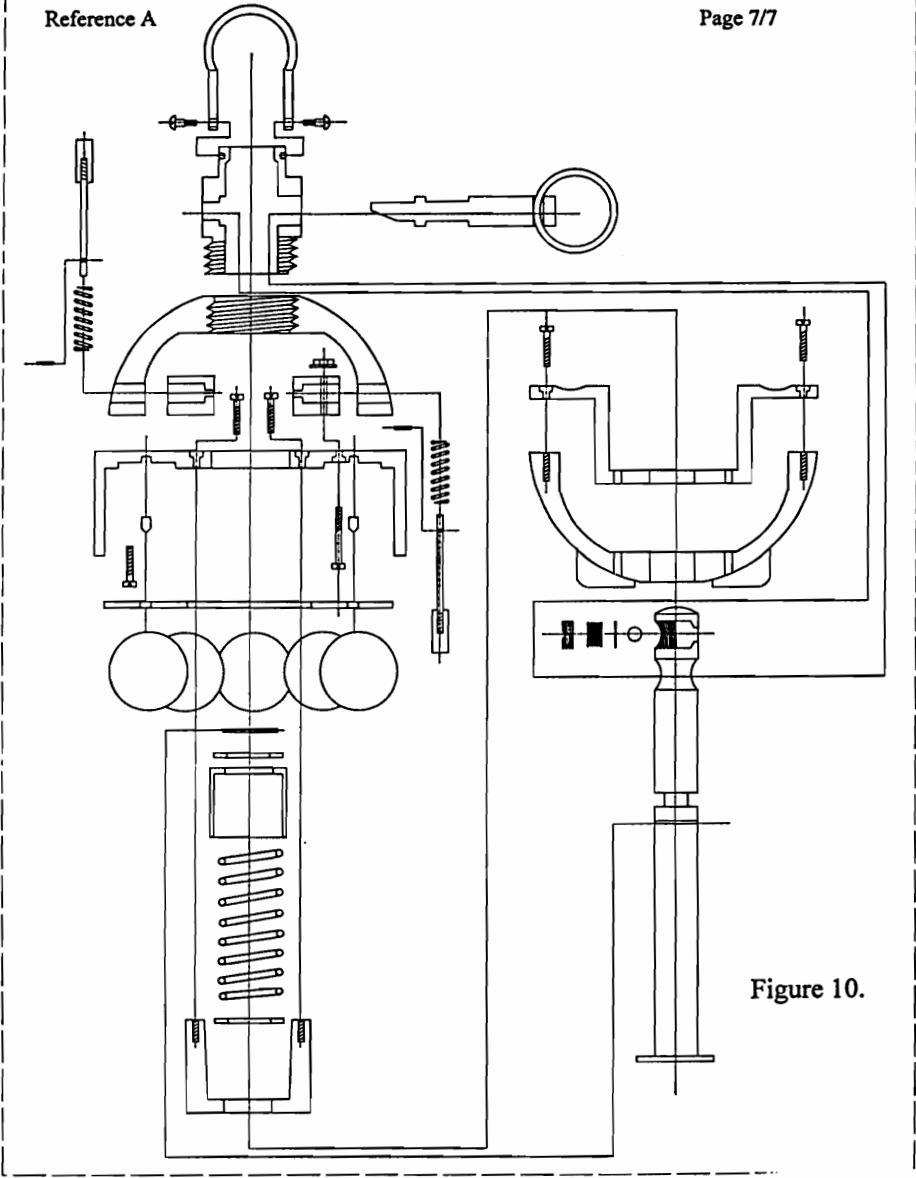
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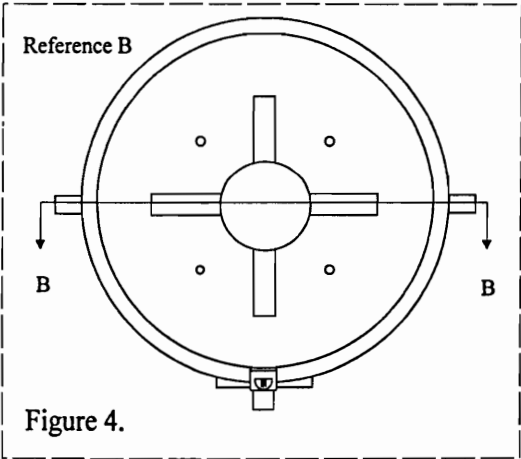
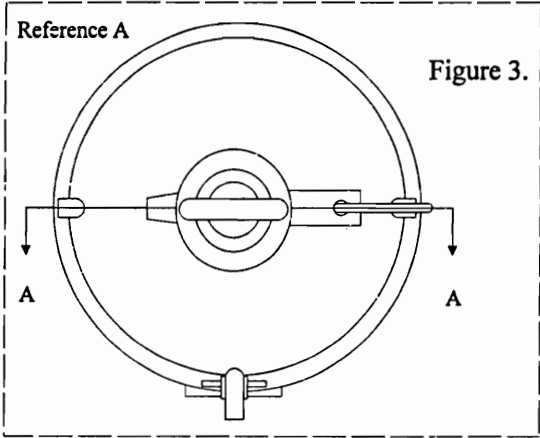
Reusable Paintball Grenade
C.L.Lush

7222036.DS4 - Page: 7

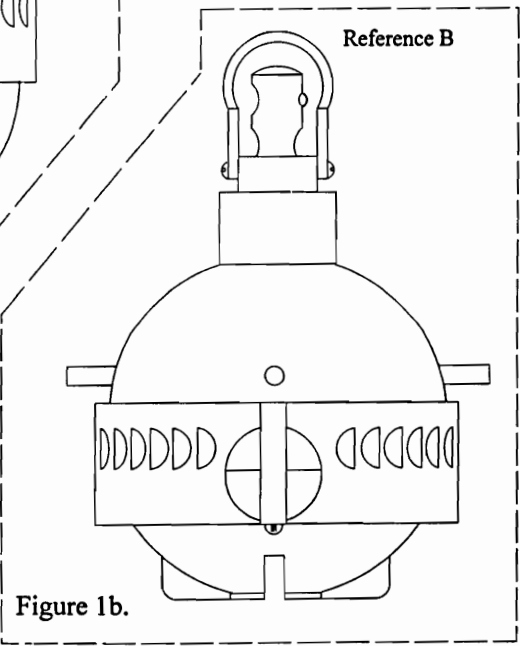
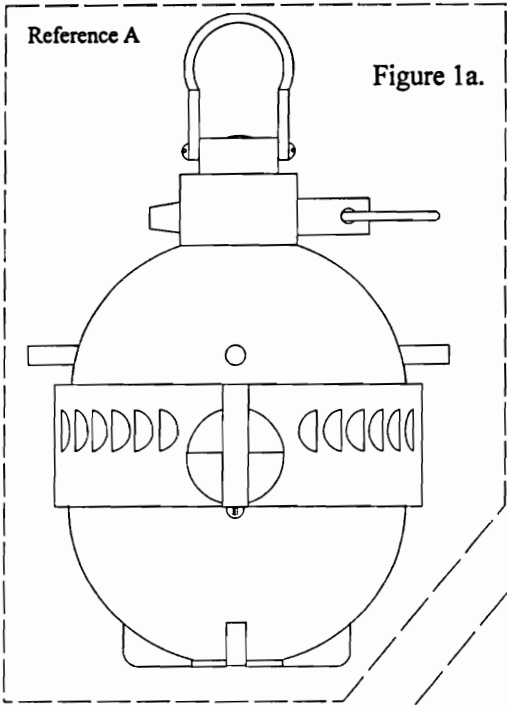
Page 7/7



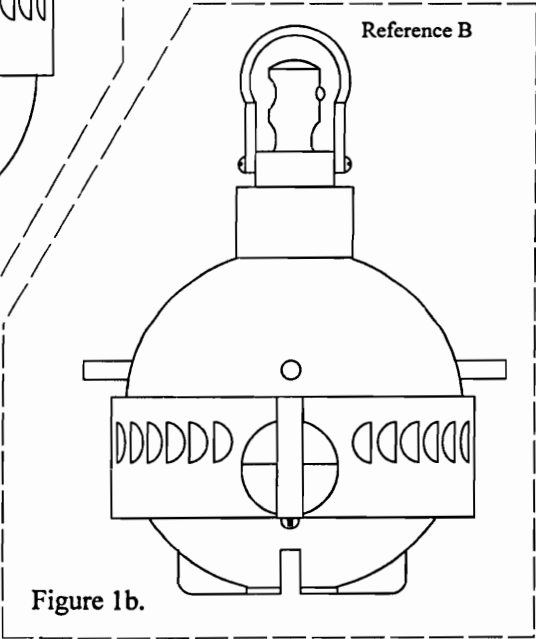
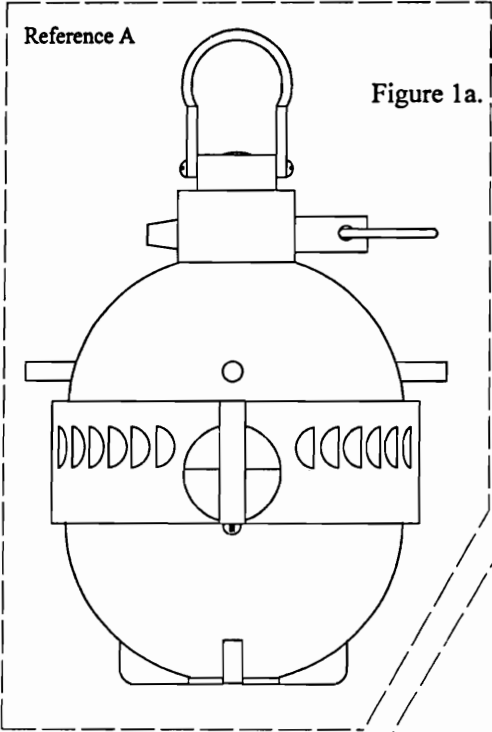
Reusable Paintball Grenade
C.L.Lush



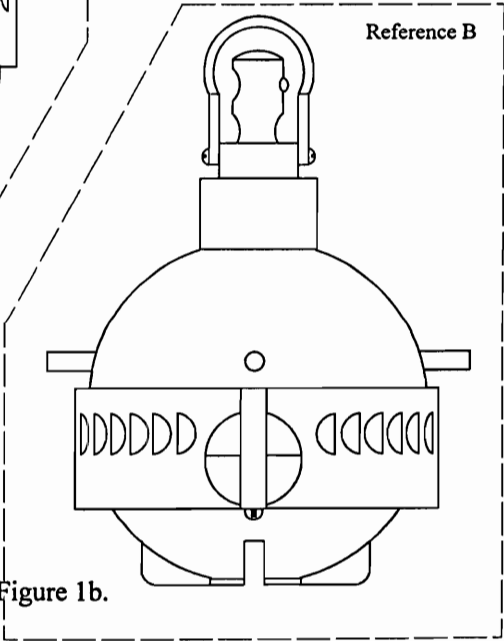
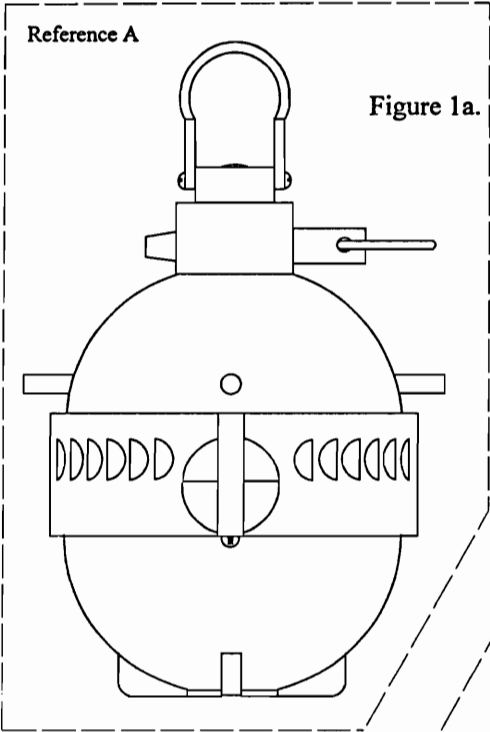
Reusable Paintball Grenade
C.L.Lush



Reusable Paintball Grenade
C.L.Lush

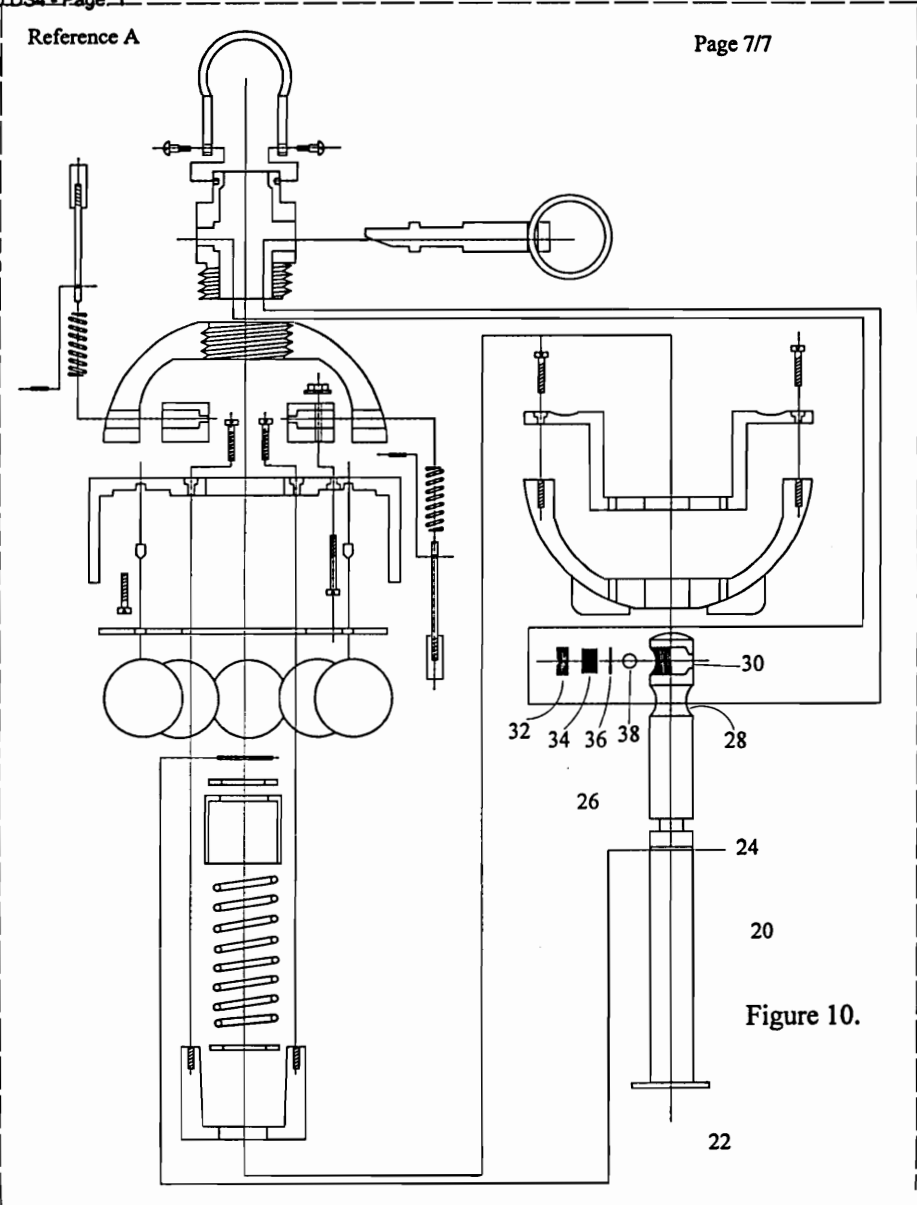


Reusable Paintball Grenade
C.L.Lush



Reusable Paintball Grenade
C.L.Lush

7231440.DS4 Page 1

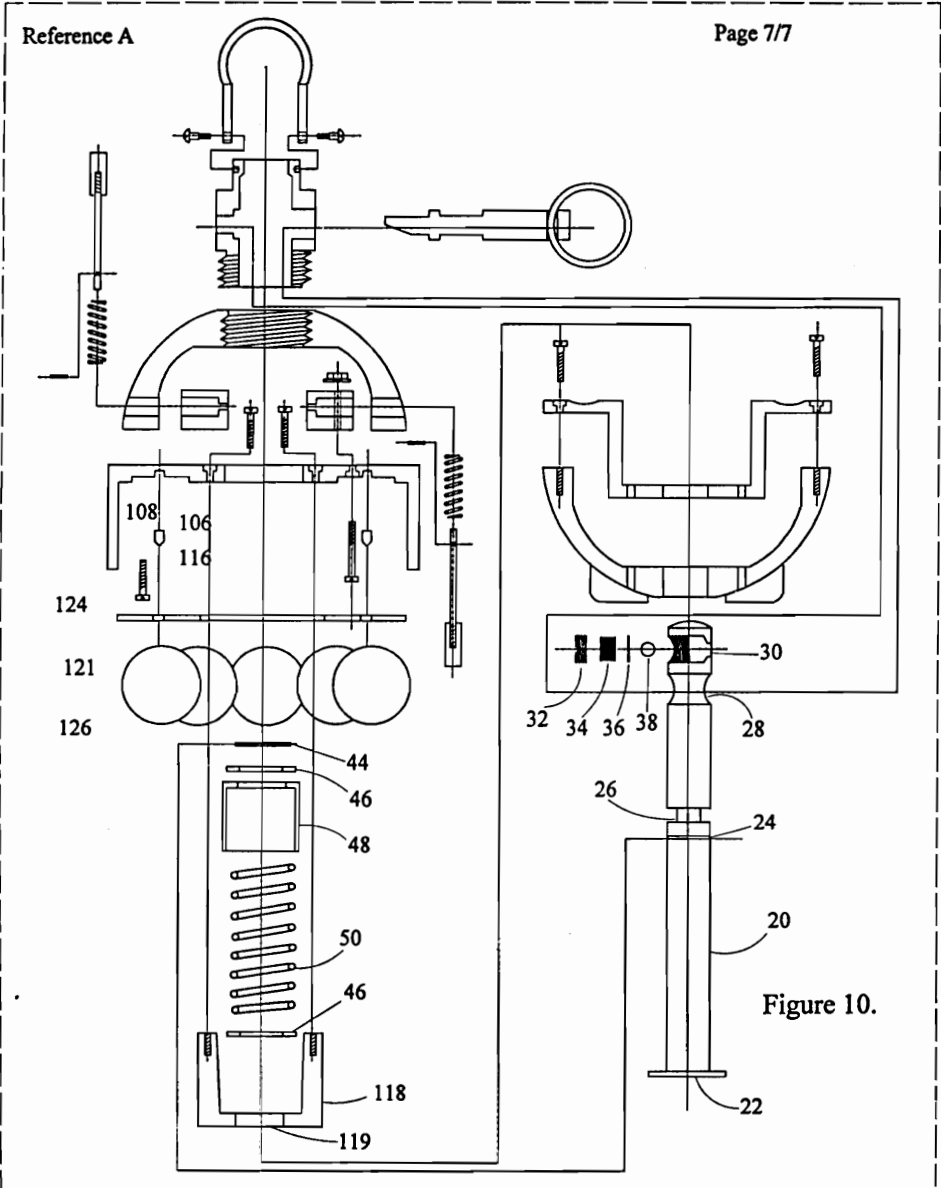


7231453.DS4 - Page: 1



Reusable Paintball Grenade
C.L.Lush

7231505.DS4 - Page: 1



7231535.DS4 - Page: 1

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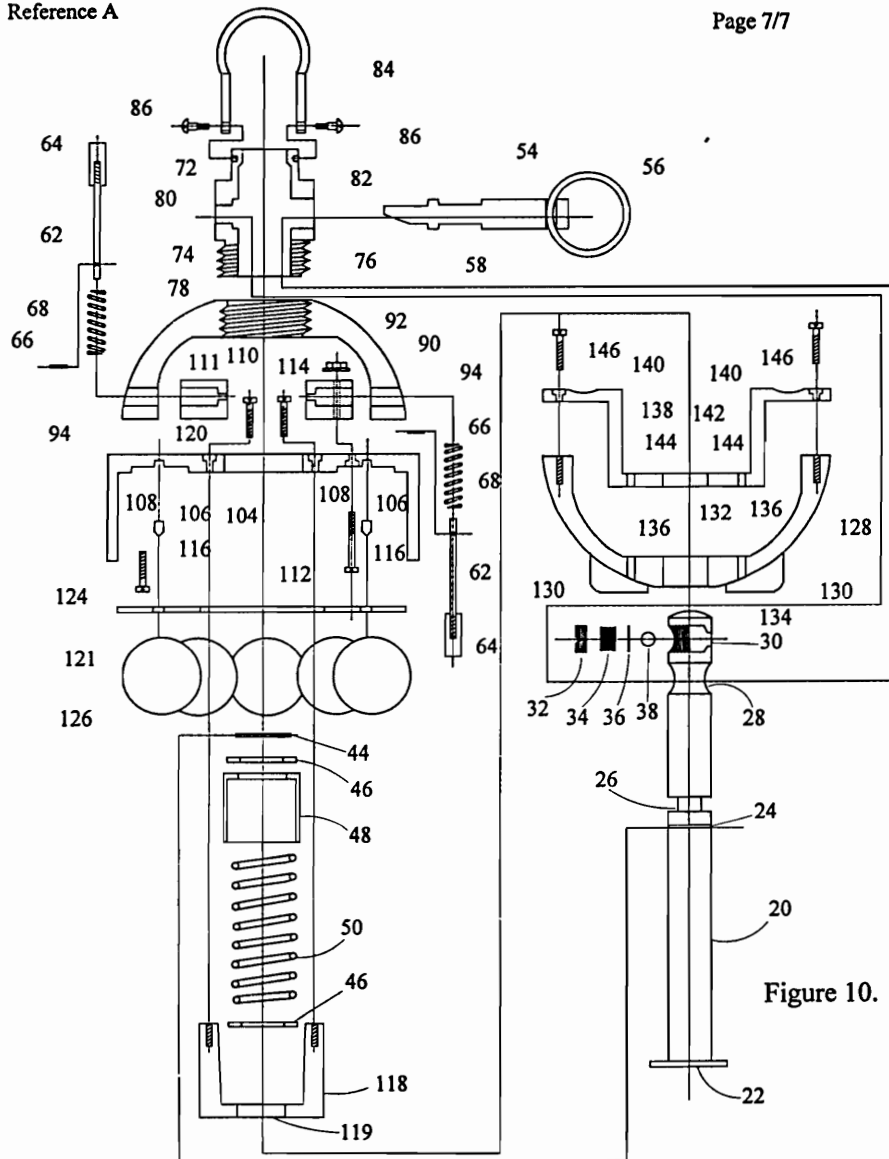


Figure 10.

Reusable Paintball Grenade C.L.Lush

7231611.DS4 -Page:1

Reference A

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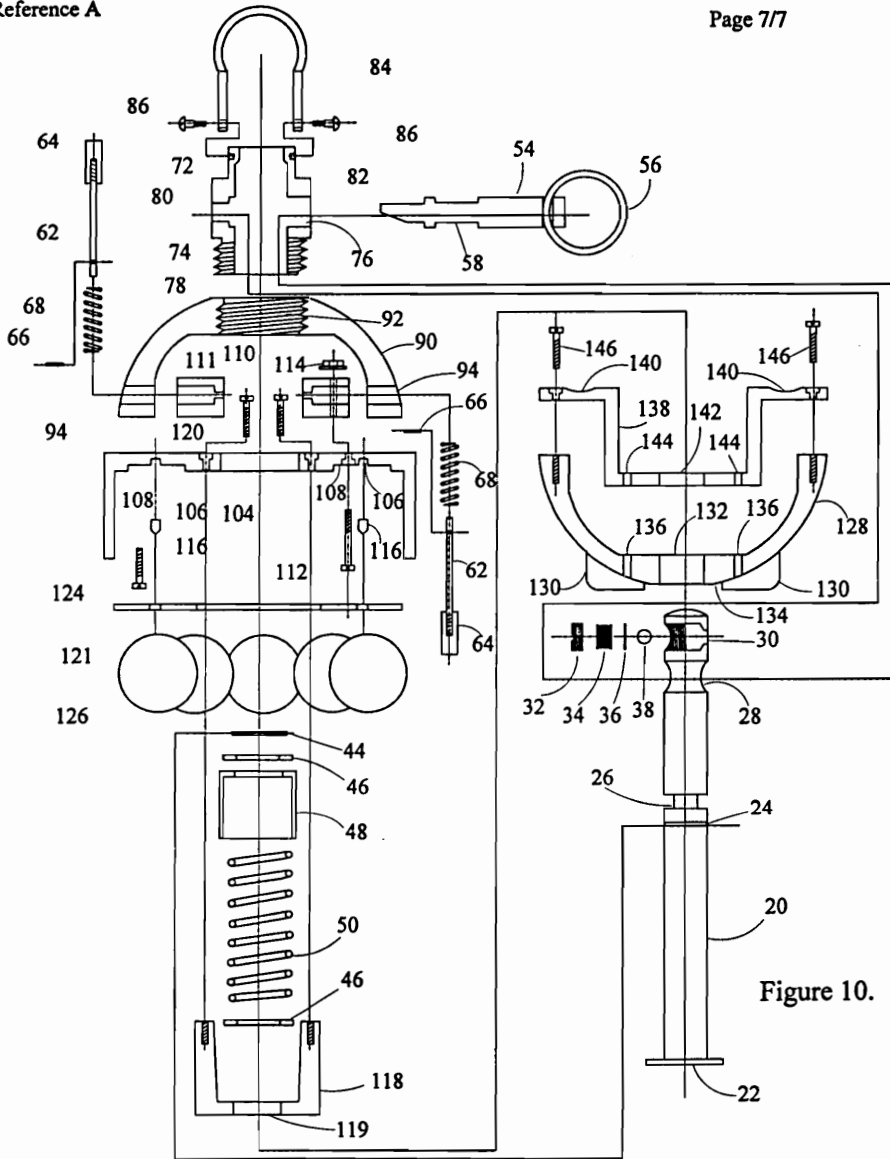
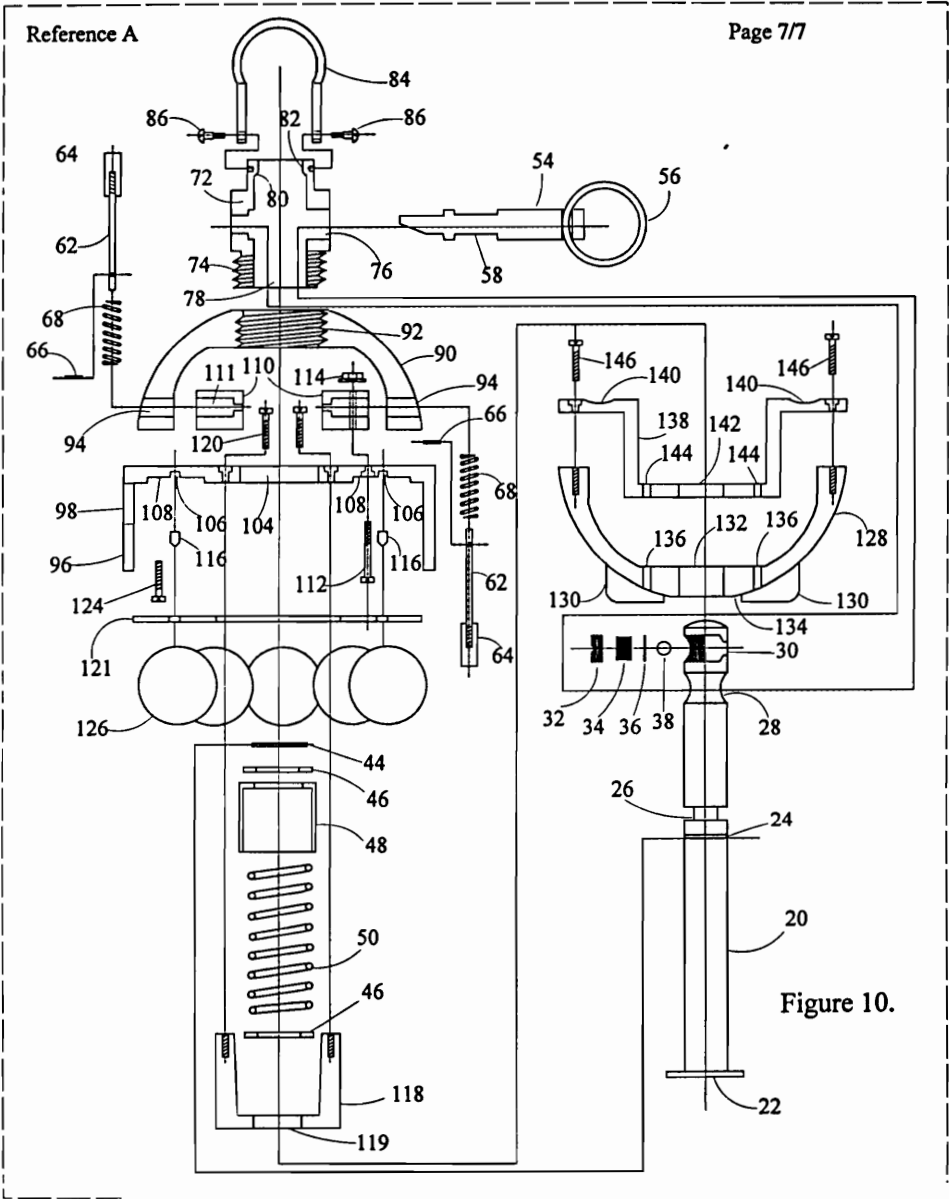


Figure 10.

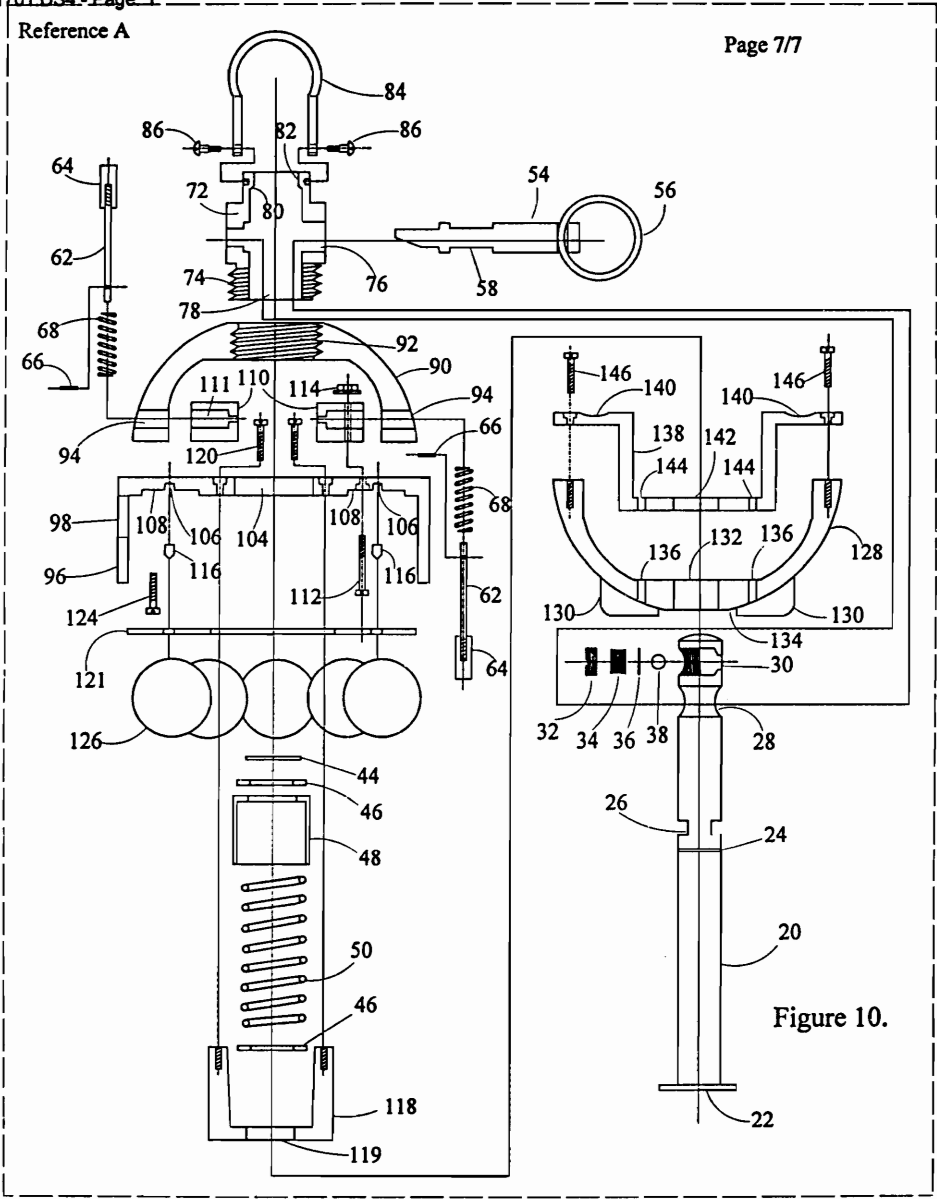
Reusable Paintball Grenade
C.L.Lush

7231631.DS4 - Page: 1

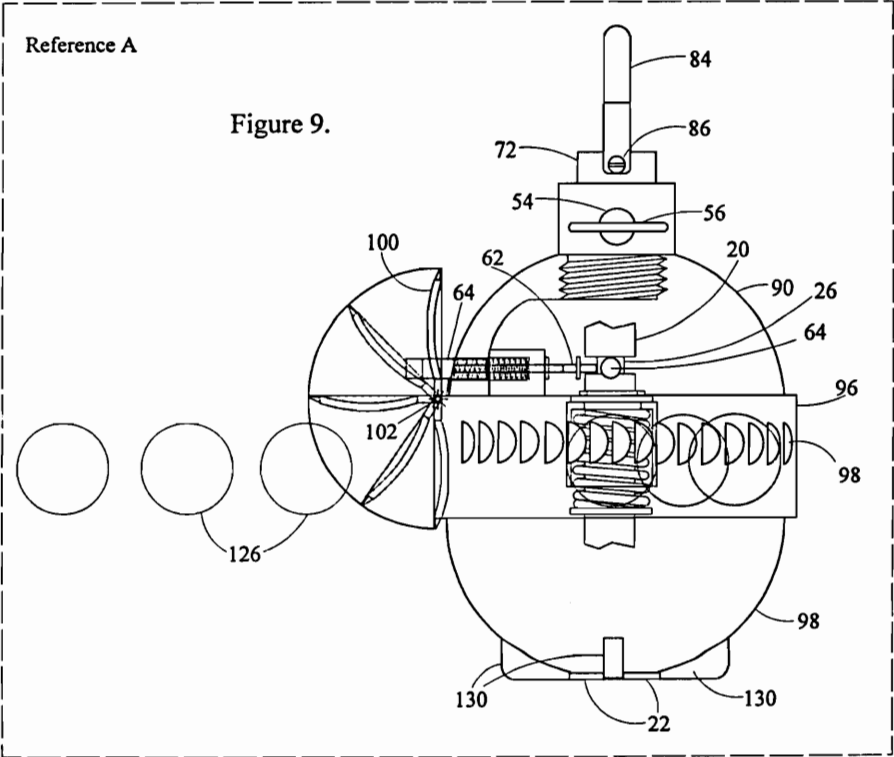


Reusable Paintball Grenade
C.L.Lush

7231701.DS4 - Page: 1



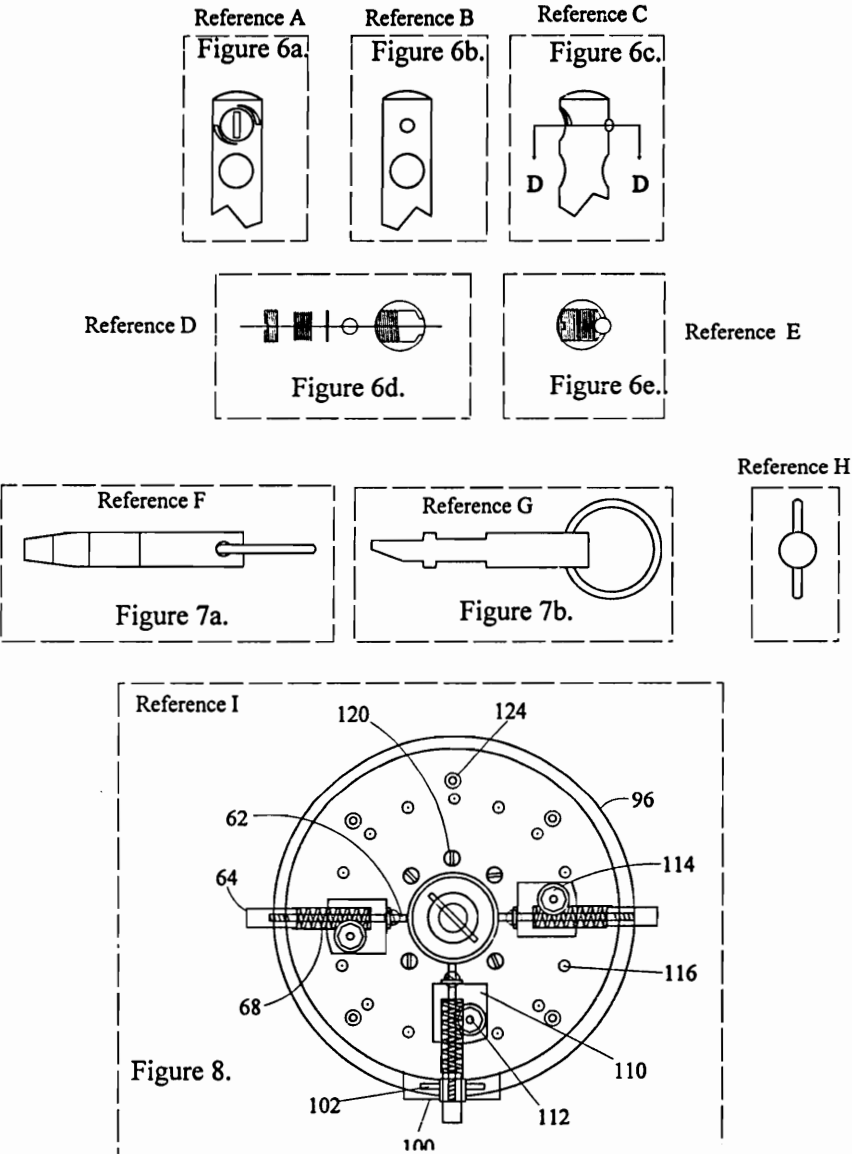
Reusable Paintball Grenade
C.L.Lush



Reusable Paintball Grenade
C.L.Lush

7231811.DS4 - Page: 1

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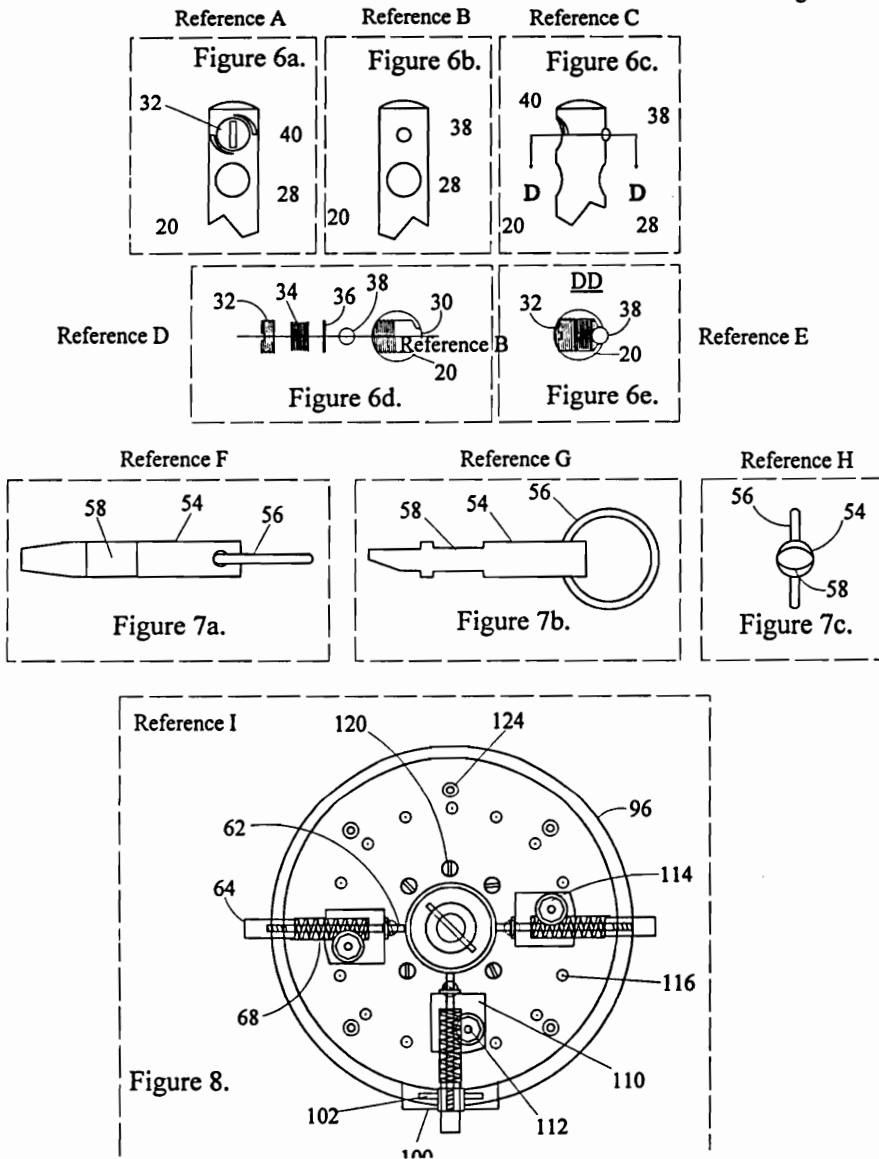


Reusable Paintball Grenade

C.L.Lush

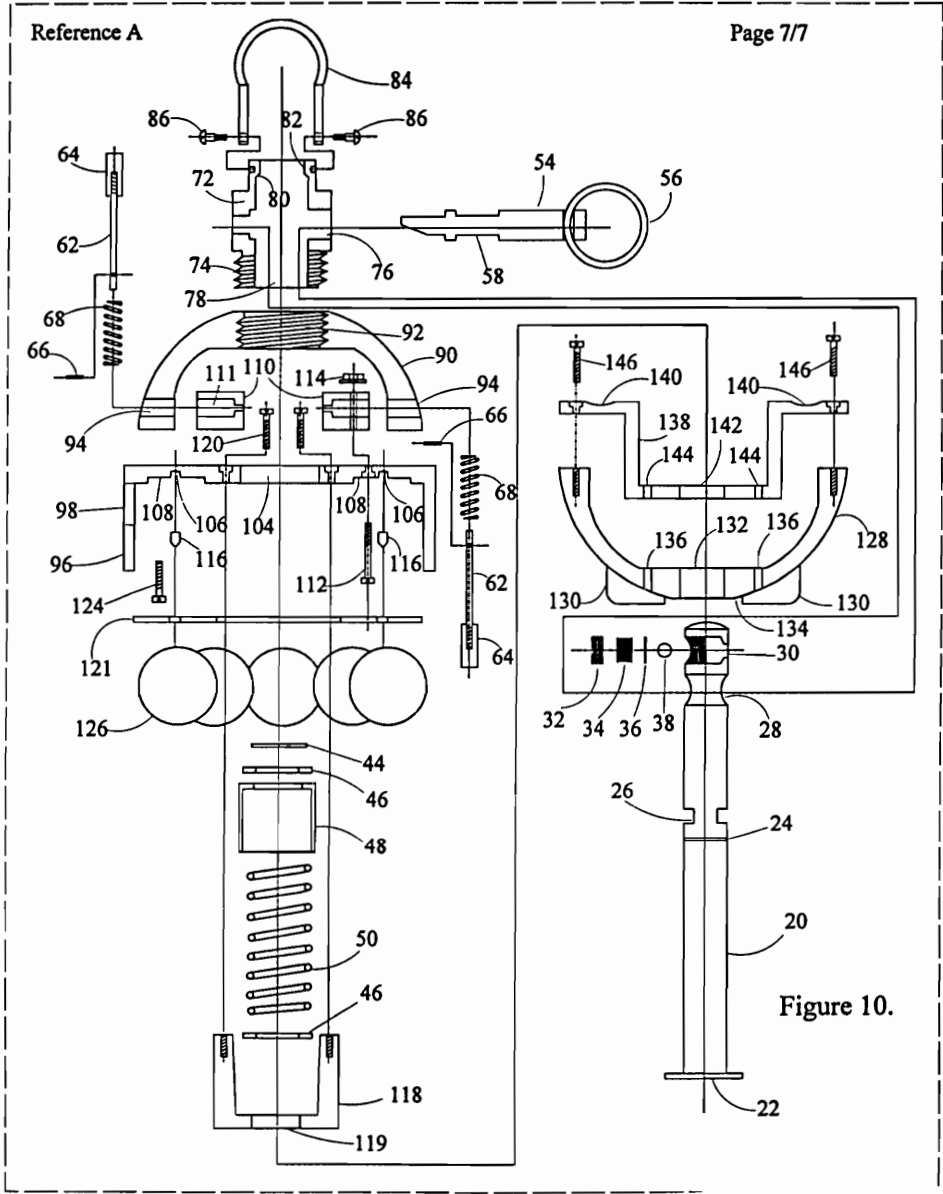
7232032.DS4 - Page: 1

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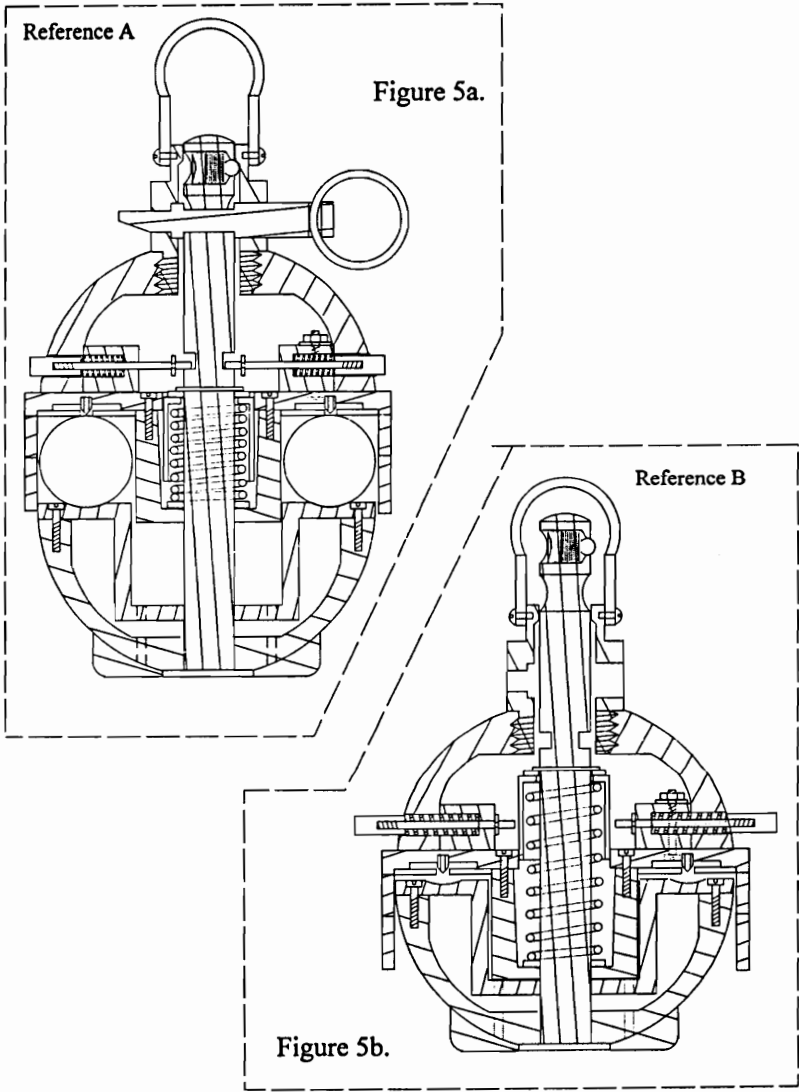


Reusable Paintball Grenade
C.L.Lush

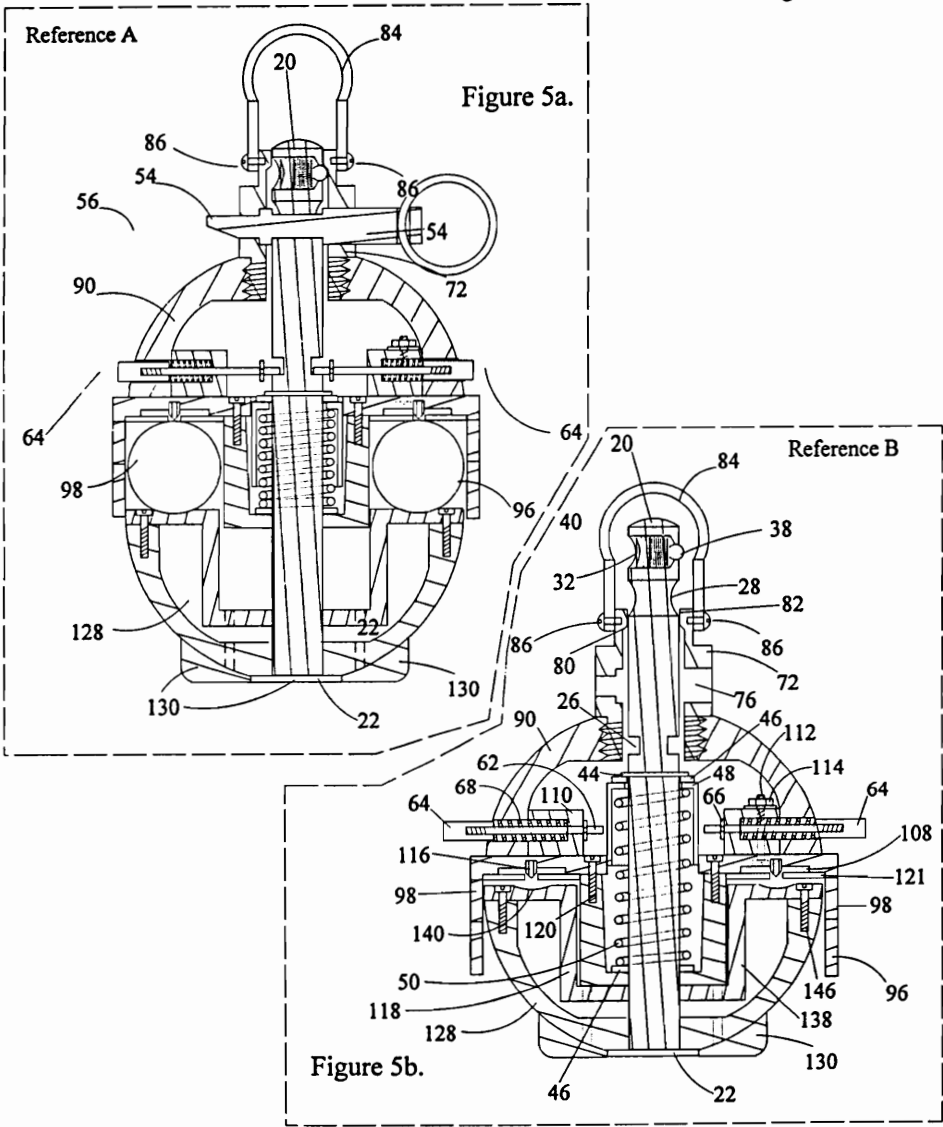
7232032.DS4 - Page: 2



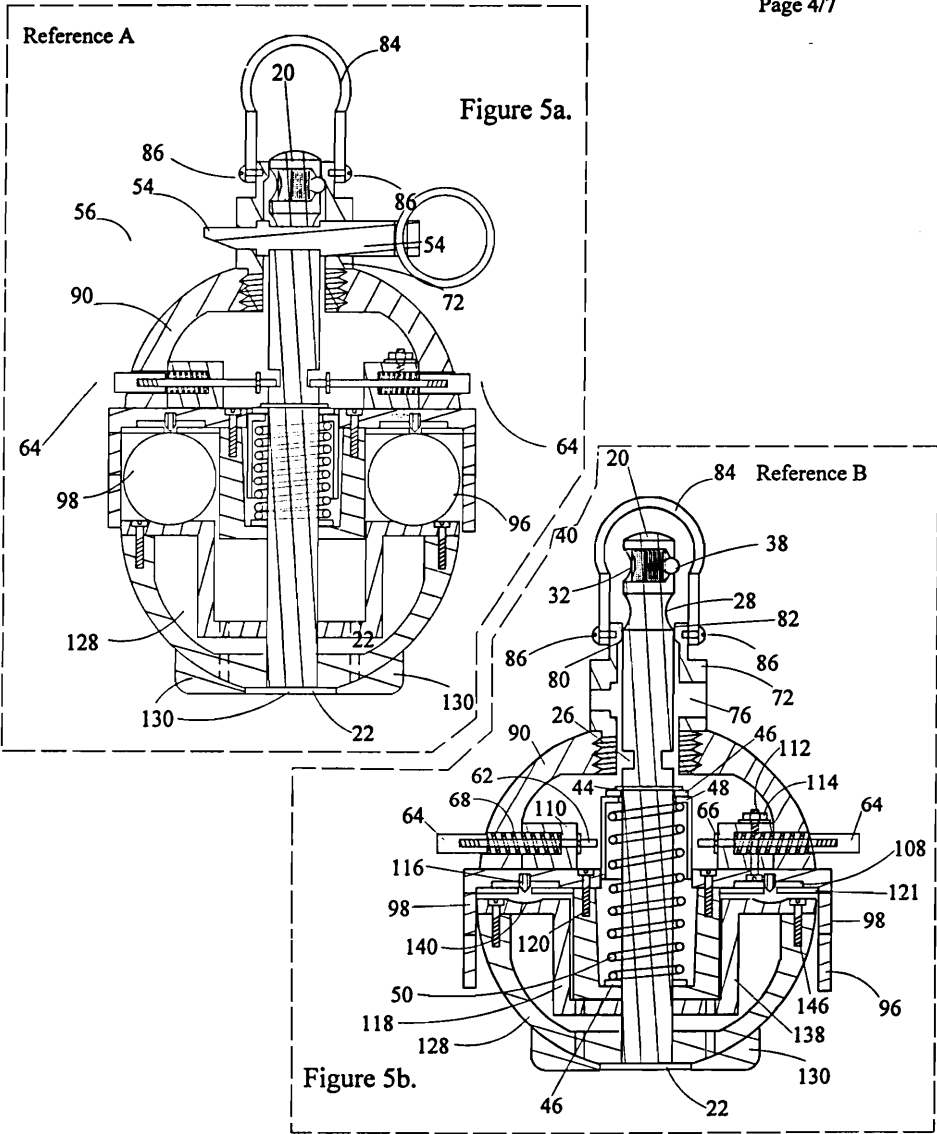
Reusable Paintball Grenade
C.L.Lush



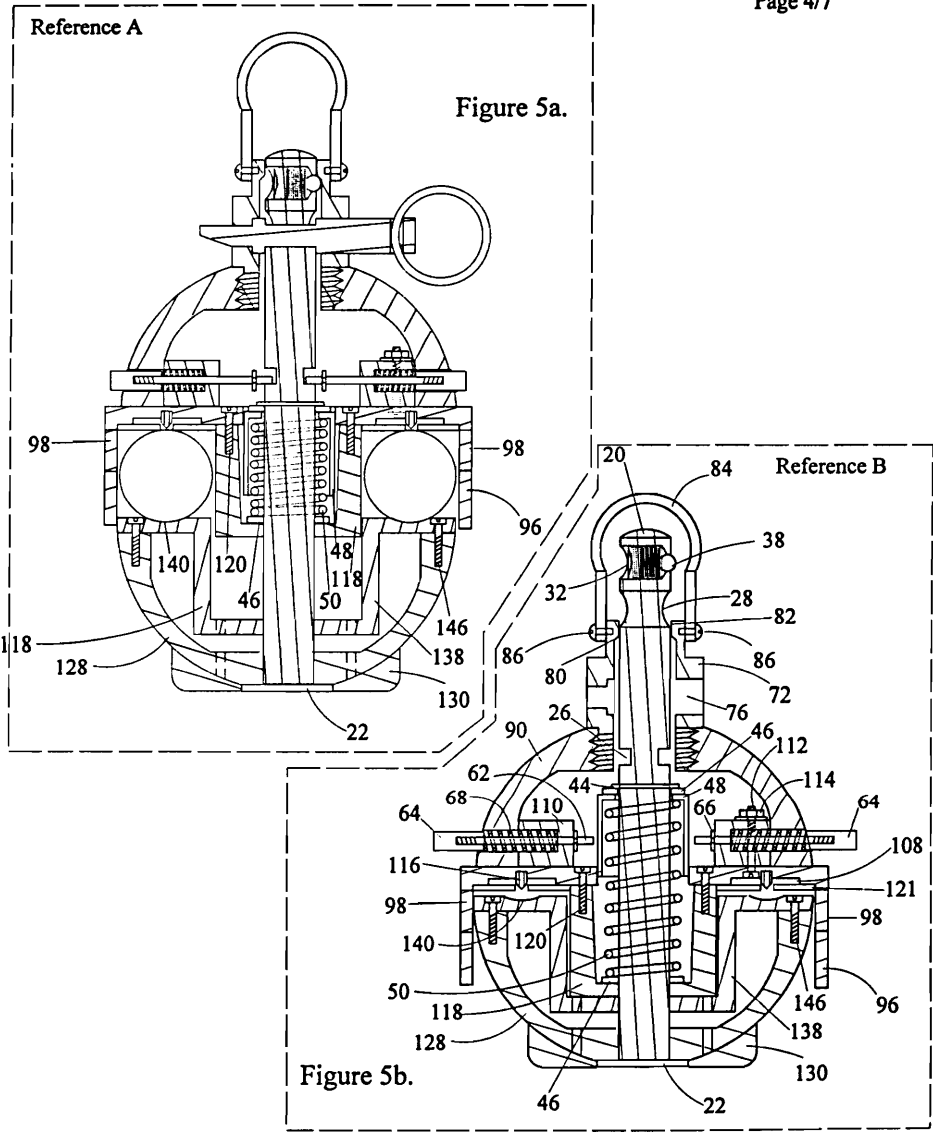
Reusable Paintball Grenade
C.L.Lush



Reusable Paintball Grenade
C.L.Lush



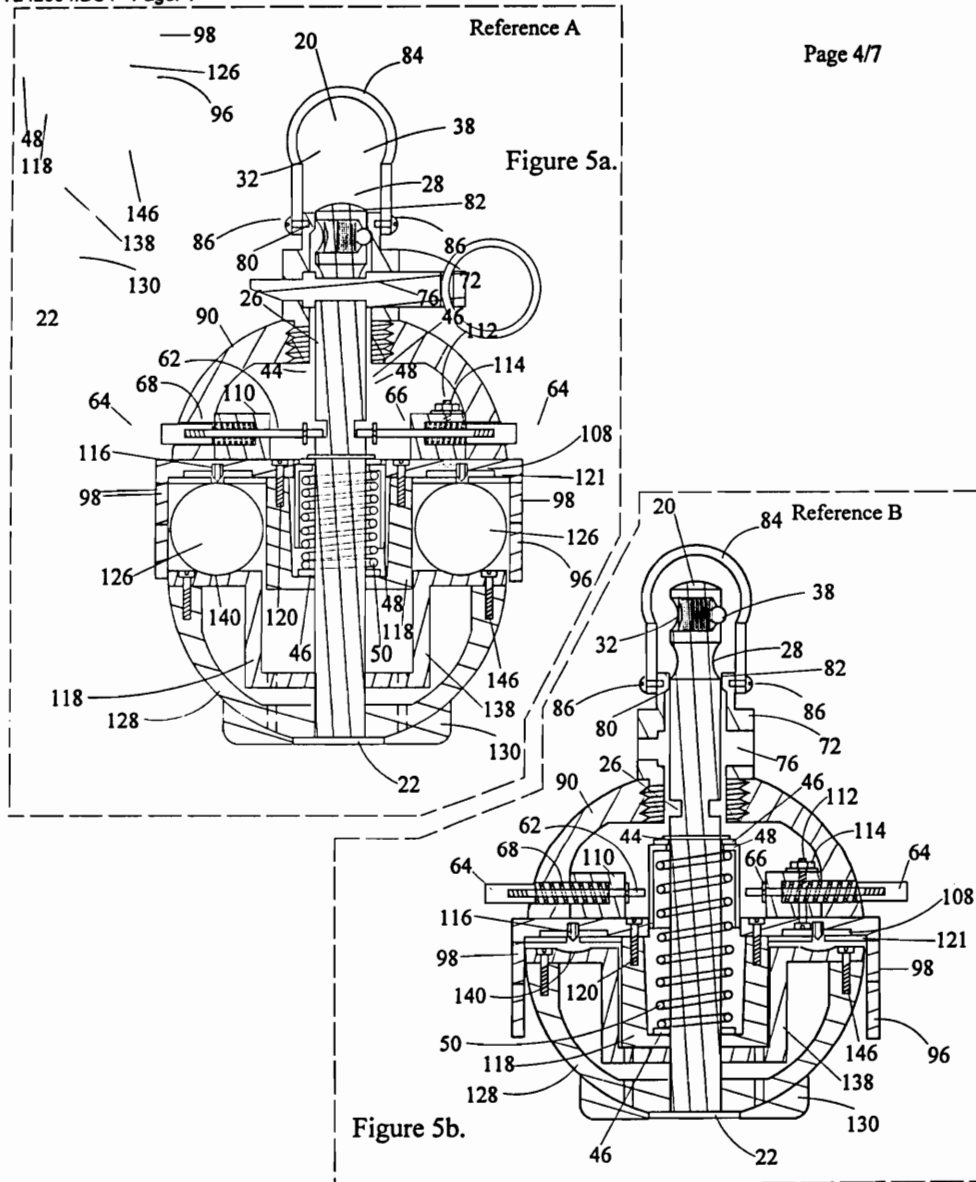
Reusable Paintball Grenade
C.L.Lush



Reusable Paintball Grenade C.L.Lush

7242004.DS4 - Page: 1

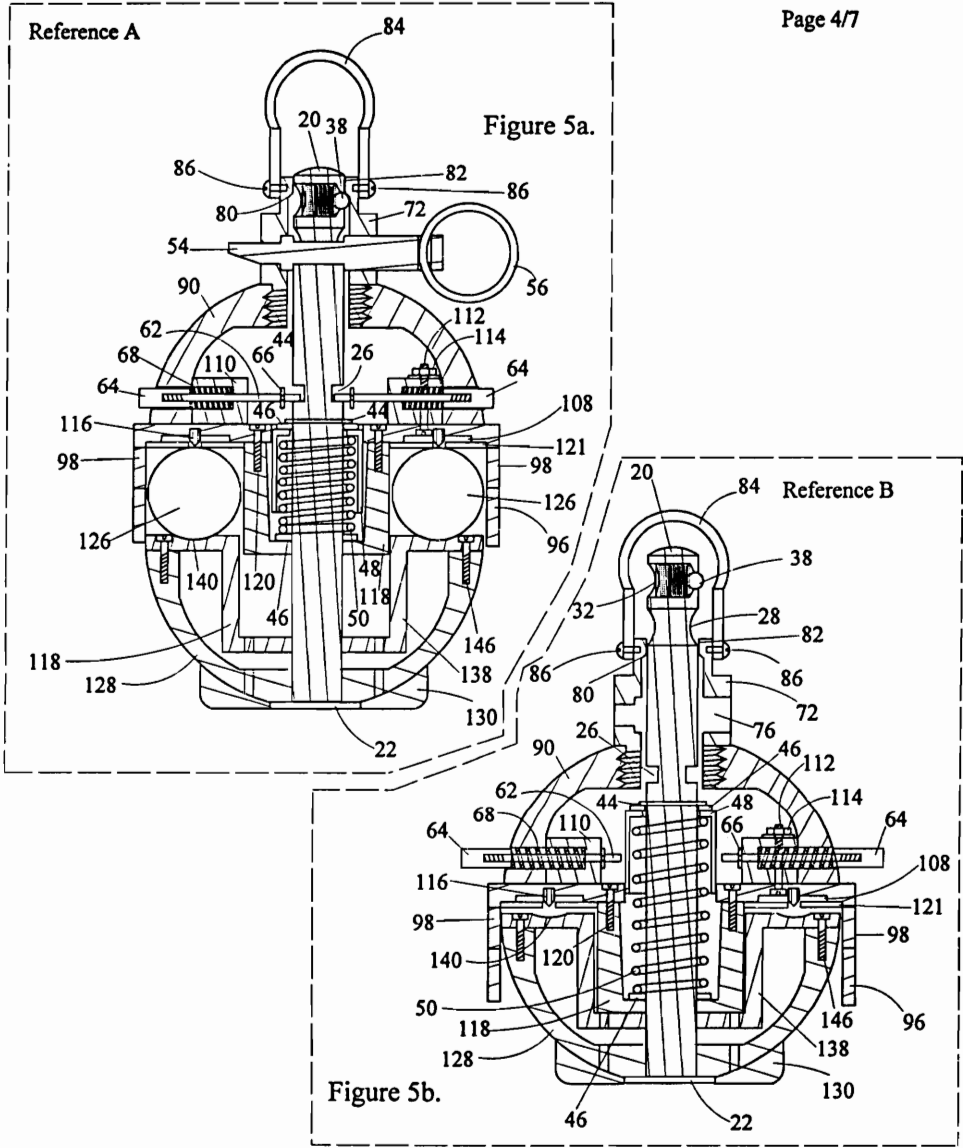
Page 4/7

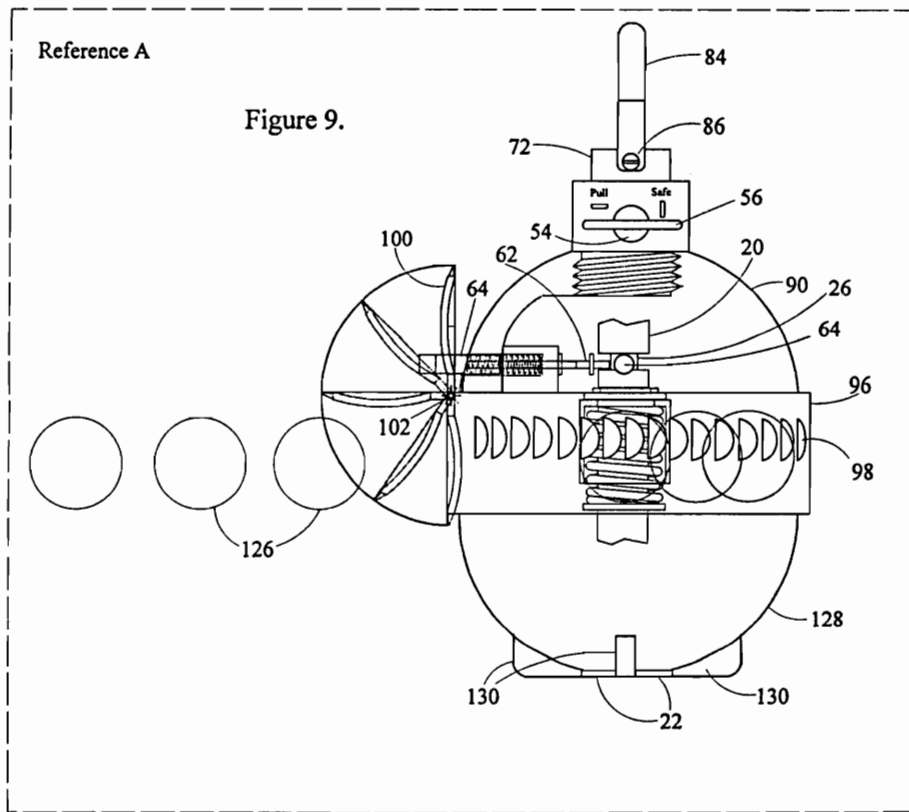


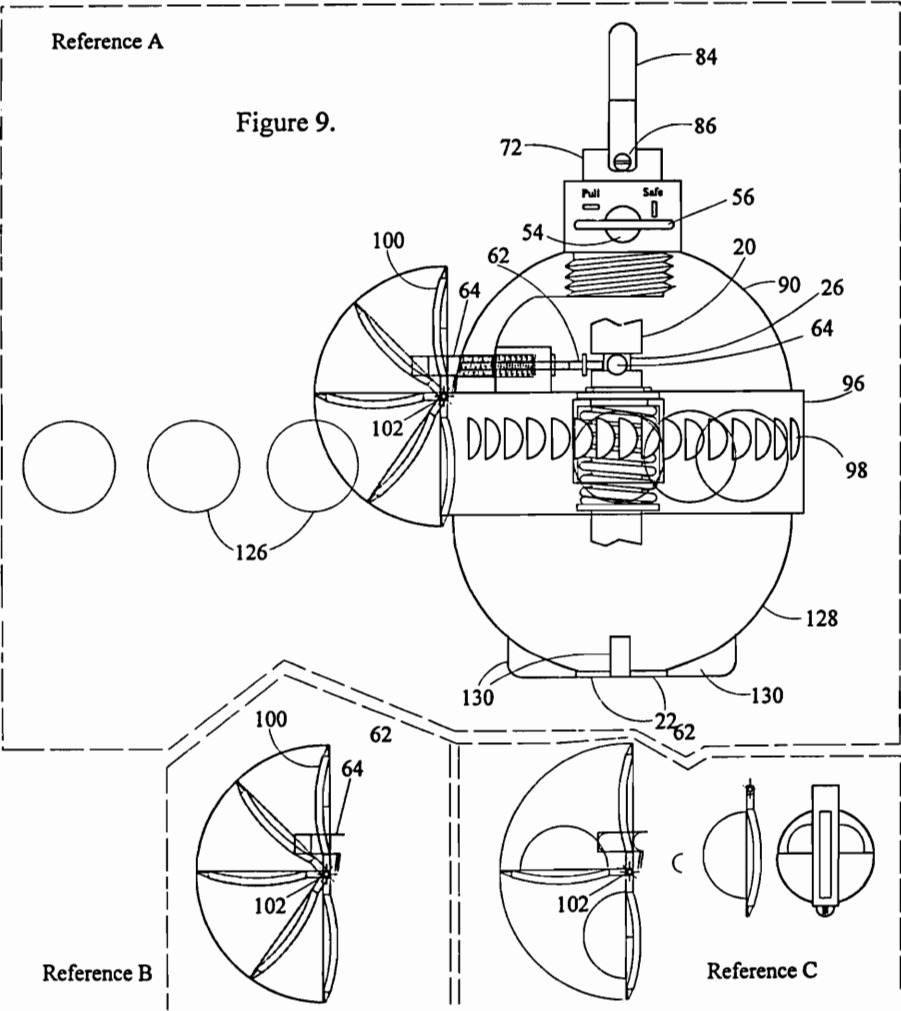
Reusable Paintball Grenade
C.L.Lush

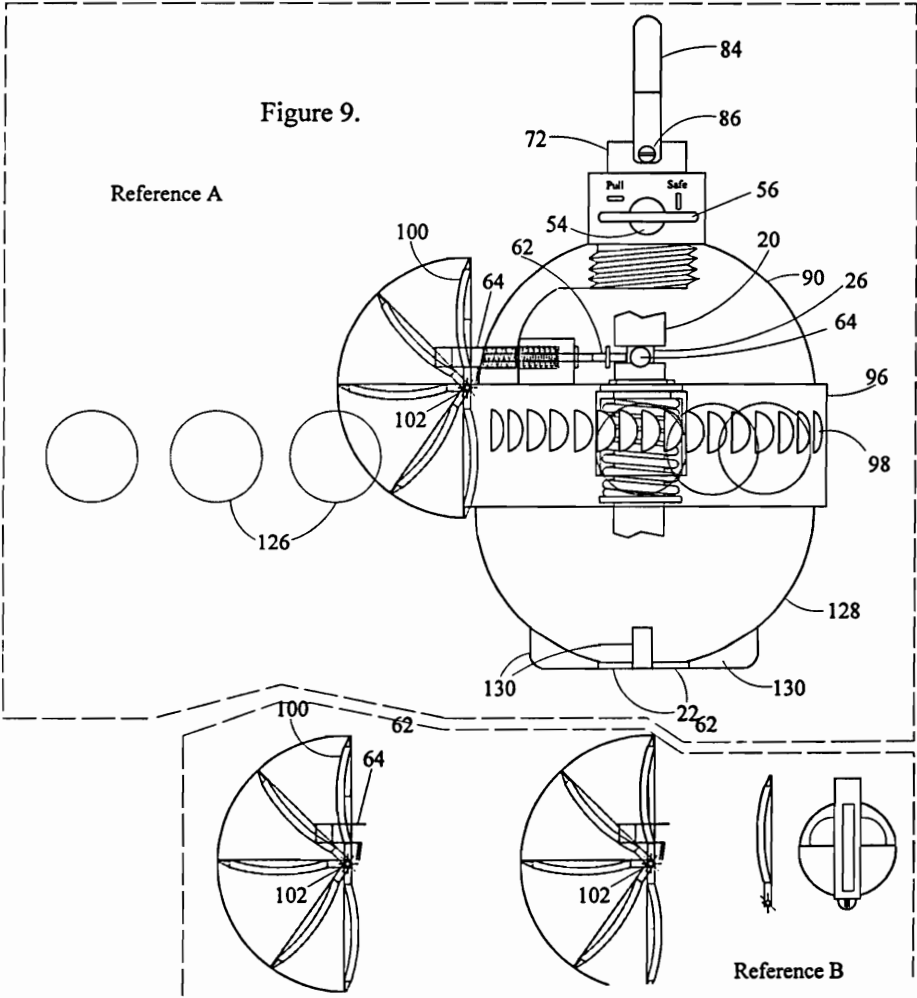
7242054.DS4 - Page: 1

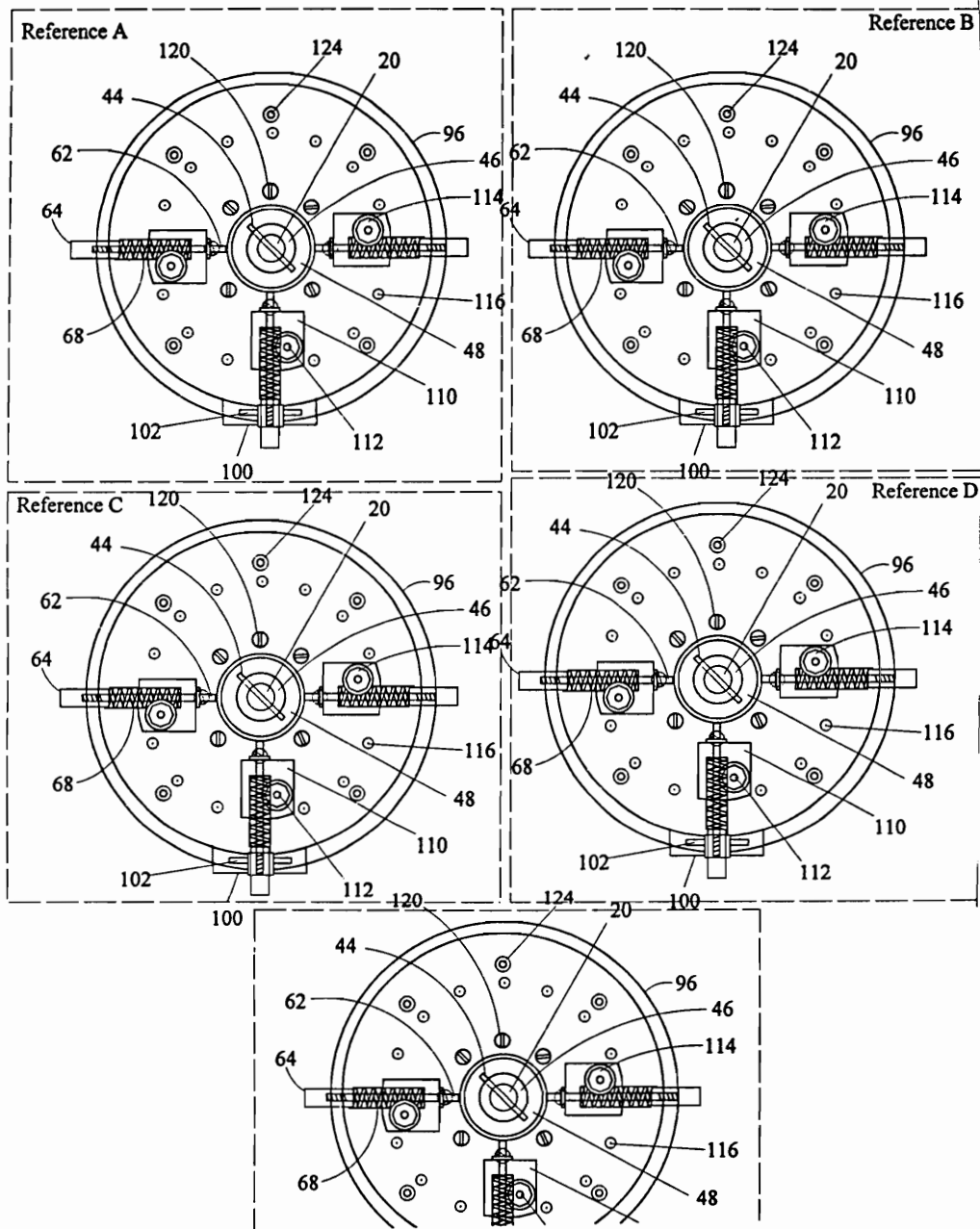
Page 4/7

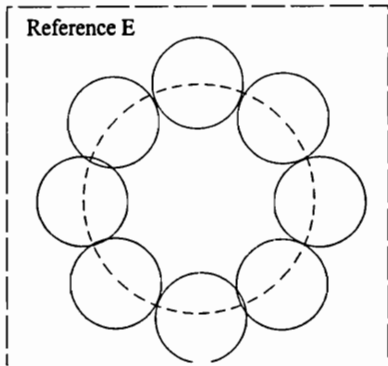
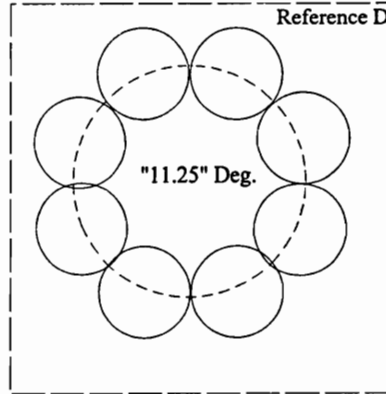
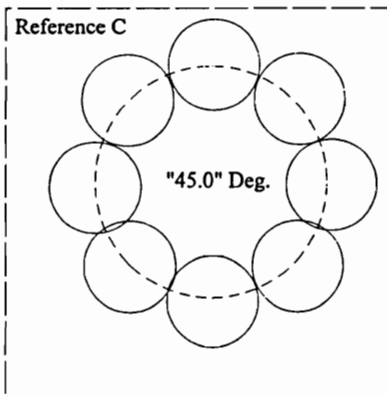
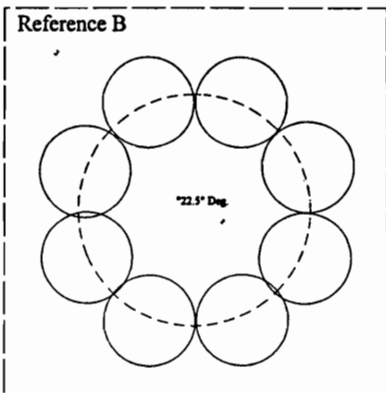
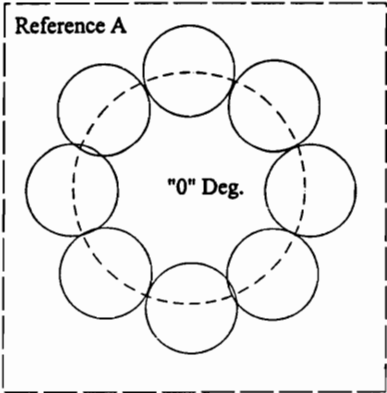


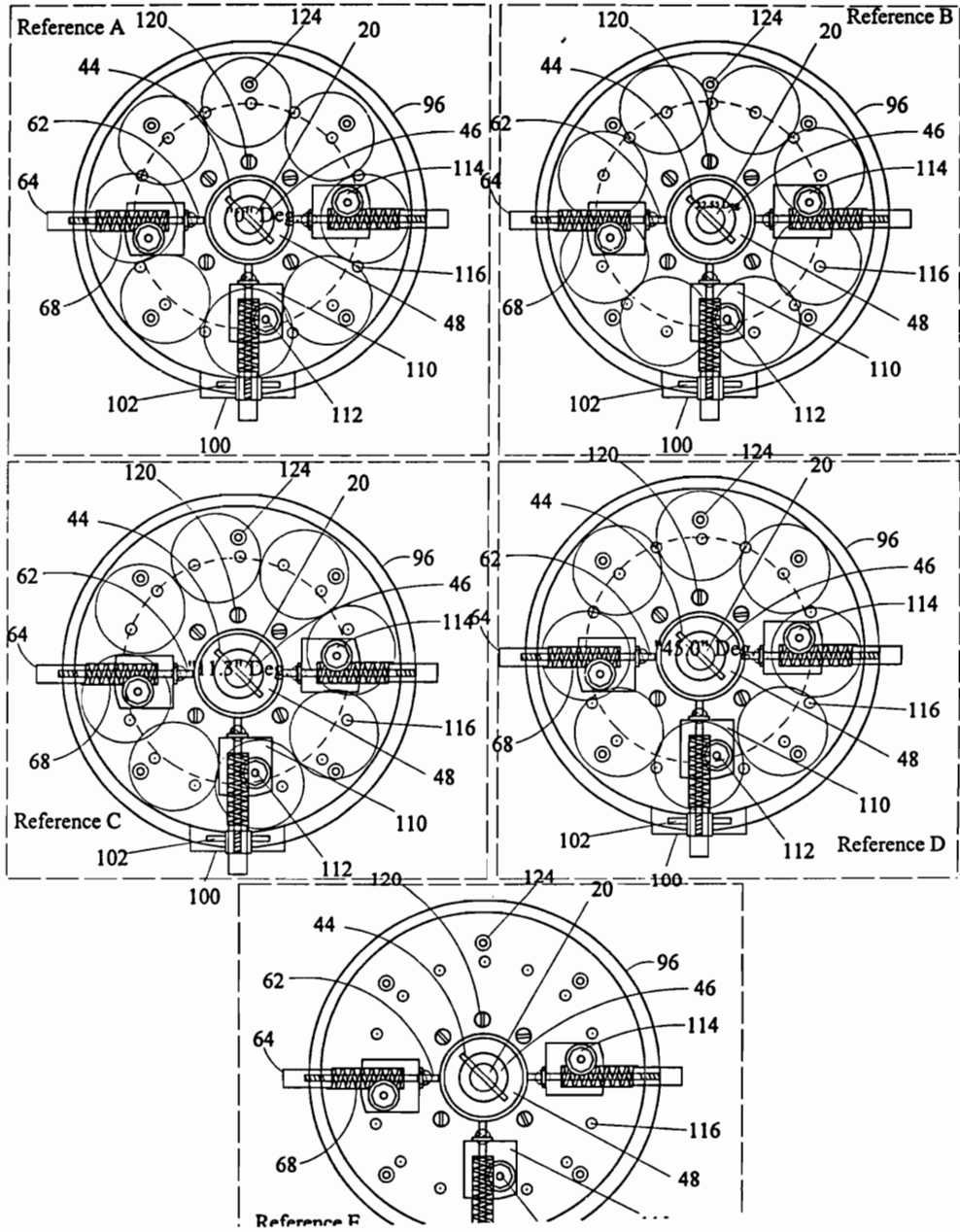












APPENDIX - D

REPRESENTATIVE SAMPLE
OF
TIME MATRIX

5291600	2755	5291700	2815	537	5291800	2875		5291900	2935	578	532000	2995	638	532100	3055	698	532200	3115	758	532300	3175	
5291601	2756	5291701	2816	538	5291801	2876		5291901	2936	579	532001	2996	639	532101	3056	699	532201	3116	759	532301	3176	
5291602	2757	5291702	2817	539	5291802	2877		5291902	2937	580	532002	2997	640	532102	3057	700	532202	3117	760	532302	3177	
5291603	2758	5291703	2818	540	5291803	2878		5291903	2938	581	532003	2998	641	532103	3058	701	532203	3118	761	532303	3178	
5291604	2759	5291704	2819	541	5291804	2879		5291904	2939	582	532004	2999	642	532104	3059	702	532204	3119	762	532304	3179	
5291605	2760	5291705	2820	542	5291805	2880		5291905	2940	583	532005	3000	643	532105	3060	703	532205	3120	763	532305	3180	
5291606	2761	5291706	2821	543	5291806	2881		5291906	2941	584	532006	3001	644	532106	3061	704	532206	3121	764	532306	3181	
5291607	2762	5291707	2822	544	5291807	2882		5291907	2942	585	532007	3002	645	532107	3062	705	532207	3122	765	532307	3182	
5291608	2763	5291708	2823	545	5291808	2883		5291908	2943	586	532008	3003	646	532108	3063	706	532208	3123	766	532308	3183	
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5291614	2769	5291714	2829	551	5291814	2889		5291914	2949	592	532014	3009	652	532114	3069	712	532214	3129	772	532314	3189	
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5291622	2777	5291722	2837	559	5291822	2897		5291922	2957	600	532022	3017	660	532122	3077	720	532222	3137	780	532322	3197	
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5291625	2780	5291725	2840	562	5291825	2900		5291925	2960	603	532025	3020	663	532125	3080	723	532225	3140	783	532325	3200	
5291626	2781	5291726	2841	563	5291826	2901		5291926	2961	604	532026	3021	664	532126	3081	724	532226	3141	784	532326	3201	
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5291635	2790	512	5291735	2850	572	5291835	2910		5291935	2970	613	532035	3030	673	532135	3090	733	532235	3150		532335	3210
5291636	2791	513	5291736	2851		5291836	2911		5291936	2971	614	532036	3031	674	532136	3091	734	532236	3151		532336	3211
5291637	2792	514	5291737	2852		5291837	2912		5291937	2972	615	532037	3032	675	532137	3092	735	532237	3152		532337	3212
5291638	2793	515	5291738	2853		5291838	2913		5291938	2973	616	532038	3033	676	532138	3093	736	532238	3153		532338	3213
5291639	2794	516	5291739	2854		5291839	2914		5291939	2974	617	532039	3034	677	532139	3094	737	532239	3154		532339	3214
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5291647	2802	524	5291747	2862		5291847	2922		5291947	2982	625	532047	3042	685	532147	3102	745	532247	3162		532347	3222
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5291650	2805	527	5291750	2865		5291850	2925		5291950	2985	628	532050	3045	688	532150	3105	748	532250	3165		532350	3225
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5291656	2811	533	5291756	2871		5291856	2931		5291956	2991	634	532056	3051	694	532156	3111	754	532256	3171		532356	3231
5291657	2812	534	5291757	2872		5291857	2932		5291957	2992	635	532057	3052	695	532157	3112	755	532257	3172		532357	

APPENDIX - E

DRAWING THREAD MAP

APPENDIX - F

REPRESENTATIVE SAMPLE

OF

PREDECESSOR MATRIX

List of Drawing	Reference Areas that Received Input from	other than their immediate predecessor.					
		Total ET	Project ET	Delta ET Hrs		Delta ET Days	
5272037	a	152	152				
5272000	a	115	115				
		37	37	0.616667	0.616667	0.025694	0.025694
5281837	a	1472	357				
5281650	b	1365	302				
		107	55	1.783333	0.916667	0.074306	0.038194
5281848	a	1483	368				
5281650	a	1365	302				
		118	66	1.966667	1.1	0.081944	0.045833
5312017	b	5893	1163				
5311446	b	5561	1071				
		332	92	5.533333	1.533333	0.230556	0.063889
6012050	b	7365	1387				
5281853	b	1488	373				
		5877	1014	97.95	16.9	4.08125	0.704167
6030825	b	9500	1678				
6022225	a	8810	1495				
		690	183	11.5	3.05	0.479167	0.127083
6032123	c,d	10278	1913				
5311446	b	5561	1071				
		4717	842	78.61667	14.03333	3.275694	0.584722
6040839	2b	10954	2139				
6012200	a	7435	1457				
		3519	682	58.65	11.36667	2.44375	0.473611
6041150	a	11085	2227				
6032243	f	10358	1993				
		727	234	12.11667	3.9	0.504861	0.1625
6041312	b	11227	2369				
6040839	g	10954	2139				
		273	230	4.55	3.833333	0.189583	0.159722
6041401	a	11276	2417				
6040839	e	10954	2139				
		322	278	5.366667	4.633333	0.223611	0.193056
6072057	a,b	16012	2529				
6032243	a,b	10358	1993				
		5654	536	94.23333	8.933333	3.926389	0.372222
6091642	f	18637	2697				
6091447	a	18522	2632				
		115	65	1.916667	1.083333	0.079861	0.045139
6091931	g,h	18806	2806 *				
6091447	a	18522	2632 *				
		284	174	4.733333	2.9	0.197222	0.120833

APPENDIX - G

REPRESENTATIVE SAMPLE

OF

PART HISTORY MATRIX

Ending	Pag	Area	Tim	94	95	96	97	98	100	101	102	103	104	105	106	107	108	109	110	111	112	114	116	118	119	120	121	122	124	126	128	130	132	136	138	140	142	144	146
5271835	1		30	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271847	1		12	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271856	1	a	9	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271902	1	b	6	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271912	1	b	10	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271917	1	a	5	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271925	1	a	8	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271931	1	b	6	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271932	1	a	1	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271940	1	b	8	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271946	1	b	6	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5271950	1	a	4	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5272000	1	b	10	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5272007	1	b	7	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5272020	1	a	13	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5272026	1	b	6	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5272030	1	b	4	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5272037	1	b	7	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5280852	1	a	38	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5280904	1	b	12	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5280914	1	b	10	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5280920	1	b	6	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281630	1	a	57	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281650	1	b	20	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281809	1	b	26	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281823	1	a	14	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281837	1	b	14	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281848	1	a	11	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281853	1	b	5	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281901	1	b	8	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
5281932	1	b	31	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z
		b		z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z

APPENDIX - H

REPRESENTATIVE SAMPLE

OF

PART HISTORY ROLL-UP MATRIX

APPENDIX - I

REPRESENTATIVE SAMPLE

OF

PART SORT MATRIX

	I	C	M	A	R	N	TD	TC	TU	U	Tot. C	ot. U	Total
20	1	8	9	4	12	15	7	7	7	567	63	574	637
21	1	1	12	4	8	3	7	7	7	558	43	565	608
22	1	0	10	0	4	7	7	1	7	438	30	445	475
24	1	3	0	1	1	1	0	0	0	188	7	188	195
26	1	0	0	0	1	4	1	0	1	178	7	179	186
28	1	0	5	1	10	5	1	0	1	312	23	313	336
30	1	5	3	1	4	4	0	0	0	163	18	163	181
32	1	0	1	2	4	5	0	0	0	184	13	184	197
34	1	1	1	3	5	3	0	0	0	170	14	170	184
36	1	0	1	2	4	3	0	0	0	161	11	161	172
38	1	7	3	3	9	7	0	0	0	291	30	291	321
40	1	0	1	0	1	3	0	0	0	60	6	60	66
44	1	2	1	1	5	6	7	0	8	356	23	364	387
45	1	0	0	0	7	0	0	0	0	22	8	22	30
46	1	2	1	1	3	3	16	1	13	256	28	269	297
48	1	0	2	1	3	5	1	0	0	255	13	255	268
50	1	12	2	1	3	3	7	0	8	294	29	302	331
54	1	0	4	0	6	7	5	0	4	380	23	384	407
56	1	1	7	1	6	7	5	0	4	428	28	432	460
58	1	2	5	0	2	2	5	0	4	224	17	228	245
62	1	2	6	7	2	5	1	0	1	235	24	236	260
64	1	5	7	11	4	10	1	0	1	311	39	312	351
66	1	2	5	5	2	4	1	0	1	235	20	236	256
68	1	2	5	3	1	4	1	0	1	234	17	235	252
72	1	18	3	0	4	8	0	0	0	486	34	486	520
73	0	0	0	0	0	0	0	0	0	0	0	0	0
74	1	4	0	0	1	2	0	0	0	220	8	220	228
75	0	0	0	0	0	0	0	0	0	0	0	0	0
76	1	1	3	0	4	2	0	1	1	290	12	291	303
78	1	12	1	0	0	2	0	2	1	255	18	256	274
80	1	0	3	0	1	2	0	0	0	101	7	101	108
82	1	0	3	0	1	2	0	0	0	101	7	101	108
84	1	3	6	0	4	9	9	0	11	489	32	500	532
86	1	1	6	0	3	8	9	0	11	411	28	422	450
90	1	14	9	0	2	10	9	1	6	582	46	588	634
92	1	1	1	0	0	3	0	0	0	259	6	259	265
94	1	0	1	2	1	3	0	0	0	202	8	202	210
95	1	0	0	0	0	0	0	0	0	4	1	4	5
96	1	13	2	1	3	9	9	3	5	546	41	551	592
97	1	4	2	4	0	2	0	0	0	6	13	6	19
98	1	8	1	3	0	5	0	2	2	356	20	358	378
100	1	6	4	6	4	7	0	0	0	289	28	289	317
101	1	5	4	5	1	1	0	0	0	67	17	67	84
102	1	8	4	8	3	3	0	0	0	122	27	122	149
103	1	5	3	5	1	2	0	0	0	49	17	49	66
104	1	1	3	1	1	1	0	0	0	27	8	27	35
105	1	7	5	7	0	5	0	0	0	220	25	220	245
106	1	0	1	0	1	2	0	0	0	231	5	231	236
107	1	0	0	0	0	0	0	0	0	0	1	0	1
108	1	2	2	0	1	2	0	0	2	239	8	241	249
109	1	1	2	0	1	2	0	0	0	228	7	228	235
110	1	4	0	4	1	4	0	0	0	226	14	226	240
111	1	3	2	2	1	2	0	0	0	155	11	155	166
112	1	1	0	4	1	4	0	0	0	196	11	196	207
114	1	1	0	4	1	4	0	0	0	203	11	203	214
116	1	1	4	2	3	4	0	0	4	276	15	280	295
118	1	3	4	0	6	3	6	1	10	314	24	324	348
119	1	0	3	0	0	2	0	0	0	224	6	224	230
120	1	1	2	3	4	3	7	1	6	265	22	271	293
121	1	1	2	0	2	2	0	0	0	234	8	234	242
122	1	0	0	0	0	1	0	0	0	49	2	49	51
124	1	0	3	1	3	3	0	1	1	264	12	265	277
126	1	7	13	12	6	2	0	0	0	286	41	286	327
128	1	12	14	0	3	9	2	2	12	523	43	535	578
130	1	1	10	1	4	9	0	0	0	431	26	431	457
132	1	0	0	0	0	1	0	1	0	47	3	47	50
136	1	0	4	0	0	2	5	0	4	256	12	260	272
138	1	6	9	1	3	2	0	0	0	284	22	284	306
140	1	4	2	0	0	1	0	0	1	58	8	59	67
142	1	0	0	0	0	1	0	0	0	47	2	47	49
144	1	0	4	0	0	2	0	0	0	206	7	206	213
146	1	0	5	0	0	3	13	0	9	145	22	154	176

APPENDIX - J

REPRESENTATIVE SAMPLE

OF

CUMULATIVE CHANGE MATRIX

						Cumulative Changes as Percentage of Total																			
				Time	Cum T	T as %	I	C	M	A	R	N	TD			Chgs	UnChgd	Total							
		1	b		423	0.045	0.1	0.09	0.07	0.02	0.04	0	0	0	0	0	0.04	0.01	0.01						
5281951	5281957	1	a	6	429	0.046	0.1	0.09	0.07	0.02	0.04	0	0	0	0	0	0.04	0.01	0.01						
		1	b		429	0.046	0.1	0.09	0.07	0.02	0.04	0	0	0	0	0	0.04	0.01	0.01						
5281957	5282004	1	a	7	436	0.047	0.11	0.09	0.07	0.02	0.04	0	0	0	0	0	0.04	0.01	0.01						
		1	b		436	0.047	0.11	0.09	0.07	0.02	0.05	0	0	0	0	0	0.04	0.01	0.01						
5282004	5282022	1	a	18	454	0.049	0.11	0.1	0.08	0.02	0.05	0	0	0	0	0	0.05	0.01	0.01						
		1	b		454	0.049	0.11	0.1	0.08	0.02	0.05	0	0	0	0	0	0.05	0.01	0.01						
5282022	5282035	1	a	13	467	0.05	0.14	0.1	0.08	0.02	0.05	0	0	0	0	0	0.05	0.01	0.01						
		1	b		467	0.05	0.14	0.1	0.08	0.02	0.05	0	0	0	0	0	0.05	0.01	0.01						
5282035	5282040	1	a	5	472	0.051	0.14	0.1	0.08	0.02	0.05	0	0	0	0	0	0.05	0.01	0.01						
		1	b		472	0.051	0.14	0.1	0.08	0.02	0.07	0	0	0	0	0	0.05	0.01	0.01						
5282040	5282059	1	a	19	491	0.053	0.14	0.1	0.08	0.02	0.07	0	0	0	0	0	0.05	0.01	0.01						
		1	b		491	0.053	0.14	0.11	0.08	0.02	0.07	0	0	0	0	0	0.05	0.01	0.01						
5282059	5282106	1	a	7	498	0.053	0.16	0.11	0.08	0.02	0.07	0	0	0	0	0	0.05	0.01	0.02						
		1	b		498	0.053	0.16	0.11	0.08	0.02	0.07	0	0	0	0	0	0.05	0.01	0.02						
5291630	5291658	1	a	28	526	0.056	0.16	0.11	0.08	0.02	0.07	0	0	0	0	0	0.05	0.01	0.02						
		1	b		526	0.056	0.16	0.11	0.08	0.02	0.07	0	0	0	0	0	0.05	0.01	0.02						
5291658	5291735	1	a	37	563	0.06	0.16	0.11	0.08	0.02	0.07	0	0	0	0	0	0.06	0.01	0.02						
		1	b		563	0.06	0.16	0.11	0.08	0.02	0.07	0	0	0	0	0	0.06	0.01	0.02						
		1	c		563	0.06	0.19	0.11	0.08	0.02	0.08	0	0	0	0	0	0.06	0.01	0.02						
5291855	5291922	1	a	27	590	0.063	0.19	0.11	0.08	0.02	0.08	0	0	0	0	0	0.06	0.02	0.02						
		1	b		590	0.063	0.19	0.11	0.08	0.02	0.08	0	0	0	0	0	0.06	0.02	0.02						
		1	c		590	0.063	0.19	0.11	0.08	0.02	0.08	0	0	0	0	0	0.06	0.02	0.02						
		1	d		590	0.063	0.19	0.11	0.08	0.02	0.09	0	0	0	0	0	0.06	0.02	0.02						
5291922	5291945	1	a	23	613	0.066	0.19	0.12	0.08	0.02	0.09	0	0	0	0	0	0.06	0.02	0.02						
		1	b		613	0.066	0.2	0.12	0.08	0.02	0.09	0	0	0	0	0	0.06	0.02	0.02						
		1	c		613	0.066	0.2	0.12	0.08	0.02	0.09	0	0	0	0	0	0.06	0.02	0.02						
		1	d		613	0.066	0.2	0.12	0.08	0.02	0.09	0	0	0	0	0	0.06	0.02	0.02						
		1	e		613	0.066	0.2	0.12	0.08	0.02	0.1	0	0	0	0	0	0.06	0.02	0.02						
5291945	5291959	1	a	14	627	0.067	0.21	0.12	0.08	0.02	0.11	0	0	0	0	0	0.07	0.02	0.02						
		1	b		627	0.067	0.21	0.12	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
		1	c		627	0.067	0.21	0.12	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
		1	d		627	0.067	0.21	0.12	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
		1	e		627	0.067	0.21	0.12	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
5291959	5292011	1	a	12	639	0.069	0.24	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
		1	b		639	0.069	0.24	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
		1	c		639	0.069	0.24	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
		1	d		639	0.069	0.24	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
		1	e		639	0.069	0.24	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.02						
5292011	5292035	1	a	24	663	0.071	0.29	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.03						
		1	b		663	0.071	0.29	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.03						
		1	c		663	0.071	0.29	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.03						
		1	d		663	0.071	0.29	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.03						
		1	e		663	0.071	0.29	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.03						
5292035	5292041	1	a	6	669	0.072	0.29	0.13	0.08	0.02	0.12	0	0	0	0	0	0.07	0.02	0.03						
		1	b		669	0.072	0.29	0.13	0.08	0.02	0.13	0	0	0	0	0	0.07	0.02	0.03						
		1	c		669	0.072	0.29	0.13	0.08	0.02	0.13	0	0	0	0	0	0.07	0.02	0.03						
		1	d		669	0.072	0.29	0.13	0.08	0.02	0.13	0	0	0	0	0	0.07	0.02	0.03						
		1	e		669	0.072	0.29	0.13	0.08	0.02	0.13	0	0	0	0	0	0.07	0.02	0.03						
5292041	5292050	1	a	9	678	0.073	0.29	0.13	0.08	0.02	0.13	0	0	0	0	0	0.08	0.03	0.03						
		1	b		678	0.073	0.3	0.13	0.08	0.02	0.13	0	0	0	0	0	0.08	0.03	0.03						
		1	c		678	0.073	0.3	0.13	0.08	0.02	0.13	0	0	0	0	0	0.08	0.03	0.03						
		1	d		678	0.073	0.3	0.13	0.08	0.02	0.13	0	0	0	0	0	0.08	0.03	0.03						
		1	e		678	0.073	0.3	0.13	0.08	0.02	0.13	0	0	0	0	0	0.08	0.03	0.03						
		1	f		678	0.073	0.3	0.13	0.08	0.02	0.14	0	0	0	0	0	0.08	0.03	0.03						
5292050	5292102	1	a	12	690	0.074	0.3	0.13	0.08	0.02	0.14	0	0	0	0	0	0.08	0.03	0.03						
		1	b		690	0.074	0.3	0.13	0.08	0.02	0.14	0	0	0	0	0	0.08	0.03	0.03						
		1	c		690	0.074	0.3	0.13	0.08	0.02	0.14	0	0	0	0	0	0.08	0.03	0.03						
		1	d		690	0.074	0.3	0.13	0.08	0.02	0.15	0	0	0	0	0	0.08	0.03	0.03						
		1	e		690	0.074	0.3	0.13	0.08	0.02	0.15	0	0	0	0	0	0.08	0.03	0.03						
		1	f		690	0.074	0.3	0.13	0.08	0.02	0.15	0	0	0	0	0	0.08	0.03	0.03						

APPENDIX - K

REPRESENTATIVE SAMPLE

OF

SAFETY MATRIX

APPENDIX - L

TRANSCRIPTS OF VERBAL SAMPLES

30 May 2133

Subsequent Thought
Visualization
Emotion

In a BFO, it occurs to me that I can't fix the bail, as I was discussing earlier today, because the bail has got to swing out of the way and allow, by grasping the finger guard, the compression of the actuation spring on any hard surface. So much for that.....

31 May 0915

Time
Stress

Design

Function

Function

Safety

Design

Function

I'm on my way to the Benz dealership, and I'm wondering how I'm going to get anything of consequence accomplished in the next hour or so.... Casper needs to go in for an oil change. In the process of rethinking the work of last night, I guess I'm pleased with the feet, they make a certain amount of sense, but I haven't really come to grips with the finger guard though. I guess what troubles me is the impact the finger guard is going to have on the dispersal of the paint. Because it is not a tight seal, what might be defined in hydraulic terms as a nonpositive displacement....everything that is in the paint balls is not under pressure to come out through the holes...I'm going to have a difficult problem with dispersal...unless I can come up with voids within that finer guard that will preclude the insertion of fingers, or anything else that might do damage, in other words, a twig or something that got in there and was snapped around inadvertently....and yet still allow the paint to be dispersed..It would be real nice if the pattern of the void of the holes in this guard were aesthetically pleasing or in consonance with the overall design of the mechanism. The problem is that the paint, once punctured, will start dispersing over the range of travel...top and bottom piece travel... and as a result the percentage of paint available at the beginning of travel is considerable less than that available at the end of travel...maybe I need to do the math and determine when it will start exceeding the bounds of the troth..

31 May 0921

Development Process

It occurs to me that the process that I have been going through, this part development is concurrent...I don't have a specification yet. Yet progress is being made and I'm refining that progress and of right now, I haven't had to rebuy much real estate. Maybe my process can be enhanced if I also work on the patent application....Because with the patent application, I will do some of the things I have been putting off, such as labeling the parts, and starting to describe the mechanism and the process by which these mechanisms function, and as a result of that, enhance the development of the overall product.

Development Process

31 May 0945

Development Process
Privacy

Found a place to set-up in the waiting room. Concentration here is easier than I expected. Some people are looking at me, but they have no idea what I'm doing.

31 May 0951

Privacy

A mechanic just walked behind me and glanced at my screen. Did a double-take. Whistled under his breath. During his extended second look, I gave him a nasty glance over my shoulder and he moved on. Don't know why I'm so protective.

31 May 1012

Function
Emotion

Actuation mechanism is bothering me. Frustrated because I can't find a workable solution, yet somehow invigorated by the hunt.

31 May 1015

Visualization
Function
Design

I keep envisioning a slide mechanism design functioning. It's workable, but doesn't "feel" right. Lacks the authority and durability that a grenade should possess.

31 May 1026

Emotion
Visualization

Just saved. Pleased with the visual. Added Centerpost. Having trouble with transistion from visual image to two dimensional representation of 360 d. process.

Function

Cap with clearance for slipjoint haunts me. BFO was stationary post, stationary cap, movable slipring mechanism. Haven't worked it out in my head. How recock? Environment to actuate?

31 May 1030

Computer
Visualization

Let's start rebuilding this puppy. Go away extra post. Gotta see what it looks like assembled. That will help visualizing the slipring.

31 May 1034

Concentration
Manipulation

Another save. Commotion in here begining to bother me. Can't concentrate. Trying to build this accurately so will be graphically representation of the real thing.

Function

Need to redraw the upper half housing. Think about housing head interface. Think I'll quit. Car should be ready soon.

31 May 1340

Back in the office. I made quite a bit of progress this morning....while I was sitting in the waiting room at the American Service Center...my computer batteries ran for the entire time. I am eternally grateful. Think I will fire it up now, and see if I can get a little bit done before my 1500 feedback session.

31 May 1349

Emotion

Cap back in place. Let's build this thing. Still like the complexity of the spring.

31 May 1406

Concentration
Function

Phone rang. Gotta get my thought processes back.
Slip ring. Can this work. What are the necessary
clearances between the shaft and cap ID? Don't like
the nelarged cap.

Concentration
Function

Think! damit! Configuration....Wear.....
Materials.....Feros? Brass? Attachment?

Function

Slip ring with retaining pins.

Function

How installed? How Replaced?

HOW RESET??

Manipulation

How about an iris? The leaf shutter of a cmaera? No,
the arpature of a lens. Could that be spring loaded??

Manipulation
Function

Think I will draw it.

31 May 1446

Function
Manipulation

Drew additional material (washer?) on bottom of cap.
If it was spring loaded, could it reset automatically
when the device expanded??

How would the pin work with this arrangement?
Picked-off the top and put it on a second page. Should
give this some thought.

Time

For now, must go to meeting.

31 May 1750

Manipulation

I managed to get some work done, both this morning
and this afternoon. What I was doing was not
developmental as much as it was manipulating of the
drawing package. What I was doing was creating a
drawing image that can graphically depict the top
loaded grenade in the armed position without a pin,

Sample 1 Pg. 311

Privacy using the offset configuration...enough said...here comes Mona and Ethan...

31 May 1924

Manipulation Have pulled up this afternoon's drawings.

Think I will clean it up a little. Currently cluttered with collection of leftovers.

31 May 1931

Time Saved. That didn't take long. After I got the
Manipulation centerpost removed I constructed an exterior view of
Design the fingerguard. Has nice lines.

31 May 1946

Design Top half looks so good, think I will proceed with the
bottom. Picked up the drawing from this afternoon.

31 May 2001

Design Looking better. Faired the lines from this afternoon.

Clearances...

Function Alignment..

Safety Smashed fingers...how am I going to minimize the
possibility?

Emotion Anxiety.

31 May 2017

Design Saved. Top and bottom halves. Look good.
Function Actuation still an outstanding issue.

Fatigue Tired of sitting. Must get back to work. Change the
TV.

Sample 1 Pg. 312

1 June 0900

Fatigue

I'm in the office. Woke up this morning about 0325. I started to think about this and decided I was so tired, exhausted actually, that I didn't want to think about it.

Function

I'm down to the more difficult problems associated with the design, the more challenging aspects of finishing the design, and to a certain extent I'm holding back for some reason.

Discontinuity

I'm not executing....working those individually...

Manipulation

to some extent the execution of those issues is complicated by the complexity of designing on the computer.

Computer

Some of the configurations that represent the functioning of this unit. It may be the result of using a technical drawing package for what should essentially be a CAD operation.

Function

Design

I find myself thinking about other ways of accomplishing this particular mission. In other words the baseball grenade is the first thing that comes to mind, and I think I have made tremendous progress on the baseball grenade, but I find myself wondering if other types of grenades might not also be appropriate.

Association

The old potato mashers that the Germans used to have....I find that shape particularly interesting, as a former wood carver, back when fingers could be expended on carving rather than having to be saved for typing, the mallets we used to use on the wooden handled chisels were similar. I even turned a couple of them on wood lathes, over the years.

Function

The concept of a potato masher grenade appeals to me.

Marketability

What it would also do is to provide the opportunity to dispense the balls with a pneumatic as opposed to a mechanical function. Size and shape and relative simplicity of the baseball grenade precludes the introduction of commercially available propellants, in this case those that are typically found in paint ball. That would be the 35gram CO2 cartridge. If I could build a potato masher with a CO2 cartridge in the handle, much the way a battery fits in the handle of a flashlight, then that would be a source of power to dispense the paint balls in a configuration or in an environment very similar to one they experience coming out of a gunbarrel.

Function

Motivation

I have set up the computer here in my office, haven't turned it on yet. Don't have much creative energy right at the moment....don't know why...

Emotion
Conflict
Pride

Appears to be almost abnormal, and I'm torn about fighting it, since I need to get this done for dissertation, and just letting it happen. I have fought it in the past, trying to make specific deadlines for Patent filings, and know I can do it.

History

If I just let it run a normal course, I would suspend effort on this for a couple of days and eventually work on a second design for a while....then come back and mature the two designs simultaneously.

1 June 0926

Emotion
Time

As I sit and look through these drawing of the last couple of days, and I started comparing them and the progress I was making, and that gives me some enthusiasm...how much time I'm going to have today remains to be seen. I hope to get some work done.

1 June 0942

Emotion

As I sit here printing these out, it occurs to me all the

Design problems I haven't solved.

Function The problem with this offset functioning mechanism is the placement of the pin, once cocked, in other words, on the other designs there is a cam action on the pin that by twisting it 90 degrees unlocks the pin and pulls it out, and in the process causes the Dtent or the shear pin (which would have to armed at that point in time) which on the battlefield would be a real pain in the ass.....but what I haven't come to grips with, or what I haven't addressed yet is how the retaining pin would work. For an armed grenade....

Visualization

1 June 1009

Function And I sit here, looking at these documents, in particular 5311446 p. 1, and look at the pin that I had designed to work with this particular configuration and I got to thinking about the ball cutter, and how the ball cutter should work....and what should actuate it, and how to keep simple...its easy to build a ball cutter that is complex, it is difficult to build a ball cutter that works and is simple and has the potential for keeping itself clean.

Function

Function It may be some type of insert into the top, into the upper or lower troth, that upon functioning causes the retaining plastic to distort or be displaced and as a result sharp pins to come out and puncture the balls and begin the process of propagating the paint dispersal.

Visualization

Function Problems associated with that appear to be fairly few, other than buildup of paint that dries behind the flexible troth...and the other would be to make sure the design of the retaining pin was such that it precluded the balls from not only flopping around and spilling out, but also from being exposed to the pins during normal carrying. I guess what I'm saying is that the pin has to secure the relationship between the two halves to the point where

Function

the balls would not inadvertently be subjected to the slicing environment.

1 June 1130

Emotion

Design
Function
Function

I'm still at this s . It appears to me as I'm printing out some of the earlier drawings 5272037 the end of the first day, and the last drawing I made depicting a quartered as opposed to a bisected shell. The idea being the paint dispersal would be closer to unidirectional. It occurred to me that the finger guard might, could, should have openings that deflect the paint in specific areas in order to maximize the coverage around the device.

1 June 1345

Emotion

Without stopping, I have been doing nothing but printing these puppies all day long. I have printed everything through 31 May. I'm going to run them through WP to put a copyright notice on each one, before I reproduce them.

1 June 2015

Emotion
Function

Making some progress, finally. Confronted with the problem of how to pierce the balls....didn't know how to solve it, still don't.

Manipulation
Safety

Just started parts that would be necessary and what I came up with was some embedded pins that are fairly blunt, so if somebody's finger got in there it wouldn't do much damage....but adequate to puncture the balls. And a secondary piece of plastic as an offset.

1 June 2045

Function
Emotion

Process coming into focus. Don't appreciate how much progress has actually been made, but I like the growing complexity.

1 June 2145

Fatigue
Concentration
Emotion

Fatigue. Mind is slowing down. Concentration more difficult. Tomorrow if Friday. Looking forward to a weekend so I can get some things done.

Progress
Developmental Process

Maybe the momentum can keep me going. Think I will screw the fingerguard mechanism to the upper half, then I can attach the core filler to the fingerguard. How would they be assembled?

Servicability
Safety

Should they be field servicable? What about the spring under compression even when it is at rest?!

1 June 2148

Manipulation
Function

Better add a through hole for the centerpin. Needs to go through the center core and the fingergrasp.

1 June 2150

Developmental Process

Also need to work on the cap/upperhalf interface. Flush? Screwed? Glued? Pined?

Decision Abeyance.

Don't know. For now I will just go the gross interface. Maybe time will provide insight.

1 June 2155

Time
Emotion

Saved again. Just accomplished a lot in but a few minutes. Prior to that, I had been struggling for progress. Go figure.

Time
Developmental Process

Getting late. Must quit. Busy day tomorrow. One last change. The holes through the fingergrasp. How large should they be? Will have to figure out the volume and rate of collapse.

1 June 2200

Emotion

Final save. Gotta get some sleep. Happy, frustrated,

Sample 2 Pg. 317

feeling of accomplishment, anticipation of the hunt, exhausted. Can't remember when I've had so much fun.

2 Jun 2020

Activity Rate

Not a word...Haven't even thought about this today.

Did an hour of course director feedback, three hours of IP and two hours of data collection this afternoon, and went to the mall for supper.

Emotion

Absolutely nothing done going to start working on the computer right now.

Privacy

Mona will be in here so I probably won't say as much.

2 June 2045.

Manipulation

Just saved. Took the top half from last night and reconsturcted the bottom. Alignment was tricky.

Mouse acting funny. Things are jumping around.

Design

The interfaces concern me. Tolerances....hum.....

2 June 2110

Emotion
Design Process

Just came up for air. Have been modifying the interface between the fingerguard and bottom half.

Design Process

Had to change the overall length some and the bottom half a little, but added moldable part to hold balls and interface with center core.

Blowby....

Backpressure....

2 June 2130

Design

Saved. Added a foot to the front and finished the interface. Looks like some type of liner.

Function

Drainage.

2 June 2141

That foot doesn't fit.

Manipulation

Computer

I grouped the bottom pieces and moved them back.
The computer is a savior and a pain in the ass.

2 June 2139

Design Process

Secured liner to bottom half.

Function

Visualization

Interface with balls. How held in place? Where does capsule go upon complete collapse?

2 June 2149

Discontinuity

Added cutout groove for paintballs. Will hold in place and...

2 June 2200

Manipulation

Developmental Process

Saved. Refined groove in liner and added crude representation of centerpost. Put it in for thinking purposes. Nothing specific.

2 June 2212

Attention

Been daydreaming. Must get back to work.

2 June 2216

Emotion

Design

Tried to quickly finish the centerpost. Screwed it up.
Damn those clearances are going to be a consideration.

Sample 2 Pg. 319

2 June 2225

Function Saved again. Added drainholes in the liner and bottom half.

Design They must be large enough to expell the paint before it passes the centerpin and goes up into the core void.

Clearances!!

Fatigue Enough for tonight. Tired, discouraged, enthusiastic,
Emotion excited, and apprehensive all at once.

Emotion Current version doesn't seem to have the visual impact of some of the earlier. Seems flat. Lacks depth.

Fatigue Been a long week. Must hit it first thing in the morning.

2 Jun 2058

Producability It just occurred to me in a BFO, that my bottom half will have an insert to make it producible, and that insert probably ought to have a troth that the balls roll in, and it probably also have channels where the balls typically lie outward in order to expel the last of the paint through the finger guard. Probably also needs a wall or something in it so the paint balls be oriented properly. It is essential that they be oriented in such a way as to facilitate their positioning beneath the puncture pins.

Design

Design

3 June 0555

Emotion Up and at it. Still tired but anxious to get to work.
Kind of a flat expectation from last night.

3 June 0630

Improving upon the results of last night's work. The design is finally coming together. Not perfect yet, got

Sample 2 Pg. 320

Time	some things to do.... <u>have spent huge amounts of time, literally huge amounts of time drawing, concentrating on nothing but the manipulation of the lines on the</u>
Time	<u>screen. Really very difficult to do. I'm not sure I ever realized how much effort was associated with it, and yet when I think back about doing it manually, and all the associated bullshit with that, the continual copying and recopying, the degradation of each subsequent generation of copies, and the hundreds of hours I used to put into that...this is really an appropriate tradeoff. I suspect the total time might be somewhat less, but the frustration is actually distributed differently. It now is associated with trying to move a point a thousandth of an inch on a ten inch screen, but that type of precision isn't available by hand. Particularly with the HP 4 at 600 DPI, I believe it will be more than adequate to satisfy the Patent Office Drawing section.</u>
Manipulation	
Computer	
Emotion	
Manipulation	
Computer	
Time	<u>I also spend quite a bit of time on maintenance. Maintenance of the computer, generation of disks, copying files, protecting the data from loss. What I'm doing right now is making another backup disk. Simply because my previous disks are full.</u>
Computer	
	3 June 0640
Reflection	<u>Better get off the soapbox. Enough reflection already. Work to do.</u>
	3 June 0707
Attention	<u>Zenned out. Must get back to work.</u>
	3 June 0740
Attention	<u>Lost in thought. Can't remember what about. Think I will put on the TV. Feeling lonely.</u>
Emotion	
	3 June 0751
Emotion	Saved the top portion of last night's work. <u>Needed to</u>

to SOMETHING. Got to get the big Mo rolling.

3 June 0755

Design

Let's look at the cap/top half interface from a different light....

3 June 0811

Manipulation
Visualization

Redrawing the upper half. Need to think about the interface from the upperhalf's perspective, not that of the cap.

3 June 0825

Perspecitve

Just saved. Changed my perspective on the interface. Makes more sense now. Added the interface envelope for possible screwthreads.

Serviceability
Discontinuity

Damn cap must be removable in order to disassemble and replace parts. I don't know how I know that, haven't thought it through, but I just do. Should I give that some thought now.....

09 June 1430

Environment	Back at it. Haven't had time to think of it this morning. Terry took us all to lunch and I came home. <u>Sun is bright. I have kinda of a flat feeling about the project.</u> Need to continue working on the prototype design, but <u>that doesn't provide much progress toward the ultimate objective.</u> Still it needs to be done. <u>If it isn't producible, then what is the point?!</u>
Emotion	
Time	
Producability	
Manipulation	Picked up last night's drawing. <u>Must extend the refinement of the core retaining screws to reflect the other screw on-board.</u>

09 June 1447

Uncertainty	Saved the upgraded screws. <u>What now?</u>
Concentration	Maybe <u>I need to understand this thing.</u> Specifically its parts.

09 June 1455

Manipulation	<u>Have started to explode the whole. More questions than answers.</u>
Uncertainty	
Computer	<u>Must learn how to shade metal parts. Periodically I forget how easy it is to hate a computer.</u>
Emotion	

09 June 1515

Producibility	<u>Have to top half component complete. Drew the spring cavity with a truncated cone bottom, as it would be produced in its most inexpensive mode (cast then spring drilled, then thru-drilled).</u>

09 June 1522

Design	<u>Fingerguard portion was easy. Should this be the same material? What about strength? Dimensional stability?</u>

Design Bottom of core part is extremely weak. How many screws?

One washer sufficient? If so, how thick?

09 June 1549

Emotion Hit the groove. Saved centerpost and spring quickly
Manipulation came out. Bottom would be cast with feet. Thur-
Producability drilled. Bottom machined core void?

Cast or machined pin bottom?

09 June 1642

Concentration Lost in the computer. Lot of dimensioning complete,
Manipulation much left to do. Should have saved earlier.

09 June 1700

Inattention Been daydreaming. Nothing done.

09 June 1710

Inattention Can't get it back. More time wasted. Saved in an
Emotion attempt to accomplish SOMETHING!

09 June 1821

Concentration Wow. Came up for air. Sore. Stiff. Arm tired. Butt
Fatigue tired. Don't think I've moved any muscles other than
Satisfaction my mouse arm. Accomplished a lot. On a roll again.
Time Rushed. Must continue.
Emotion

09 June 1931

Preoccupation Saved. Don't know why I didn't before. Preoccupied
Discontinuity I guess. Don't know if I can recap everything that....

09 June 1945

Inattention

Just sitting and staring at the screen. Must get back to work.

09 June 2005.

Emotion

Saved what little advancement I had done. Perhaps I should quit. All I managed to do was put a screw through the bottom washer.

Producability
Marketability

It's identical to the core washer. Fewer parts, less cost.

Reasoning
Discontinuity

Does this even make sense? What is it doing? Holding in the centerpin? No. Retaining the centerpost? No. Must give this.....

09 June 2012

Link to past

Went back to 6032243 and found a Pin.

09 June 2029

Manipulation
Fatigue

Moved things around and dimensioned the pin. This certainly isn't rocket science, but It sure is tiring. Tomorrow is Saturday. Can sleep in.

10 June 0650

Emotion Must make some progress. What's missing?

Analysis If I gave this page to someone, what would they not understand?

10 June 0708

Drawing Extrapolation Started to work on the top view of the prototype bail assembly.

Concentration Drawing the front view wasn't easy, now how....
Discontinuity

10 June 0725

Computer Computers are a pain in the A__

10 June 0738

Emotion Saved the top view of the bail assembly. It was a bear to draw, and the dotted line drove me nuts.

Computer Had to learn how to rotate the screwhead so they would be in different positions.

Discontinuity Why? Because....

10 June 0747

Manipulation Dimensioned the Bail assembly. Provides the aspects of the device not called-out in the front view.

Searching What else needs to be done?

Emotion Ball Cutters. Oh, Joy!

10 June 0755

Manipulation Brought the ball cutter forward. Now must dimension.

Sample 4 Pg. 326

Emotion

Booooooooooring!!

10 June 0811

Emotion

Done and Saved. Time to get back to real work.

Link the Past
Momentum

Must go back and find the PTO drawings. Thank-you.
Back on the progress trail.

20 June 1244

Contemplation

Emotion

Emotion

Discipline

Analysis

Emotion

Just been sitting here thinking about this. Nothing in particular, just 4 or 5 interwoven thoughts. Couldn't describe the experience for the life of me. Can only be expressed as an emotion. Perhaps a combination of anxiety, anxiousness and frustration, all wrapped into one. This course has a test at the end, and that is providing some unnecessary stress.

Back to work. In a BFO, I realized that if this were a true section, the front of the spring wouldn't be visible, only the back as dashed lines. Hell.

20 June 1300

Computer
Manipulation
Emotion

Computer

Been working on this. Can't simply isolate and change the lines, must be redrawn with solid arcs and extensions, and dashed connectors behind the centerpost.

Have I complained about computers lately?

20 June 1312

Fatigue
Time
Emotion
Environment

Manipulation

Finished and saved. Exhausted. Physically and emotionally hard work. Little perception of progress for such a large consumption of time. Can't concentrate much with people around who want to talk.

One down, one to go. Must do a second for the compressed view.

20 June 1320

Concentration
Emotion

Zened out. Must do something.

20 June 1322

Manipulation
Momentum

Duplicated the Spring. Back to work.

20 June 1330

Environment

Lunch over, must pack up.

20 June 1815

Link with Past

Went back to 6192244 for material.

20 June 1830

Manipulation

Last night I started at 1930, and worked until 2300 something...and I hope to do the same thing tonight....The major problems have been solved, now it is just a matter of the bull work.

20 June 1845

Achievement
Manipulation

Finished compiling the various parts. Surprising how difficult it is to decide what parts on which pages.
Saved as 6201845.

20 June 1910

Discipline
Emotion

Back to the spring again. The king of springs strikes again.

20 June 1941

Fatigue
Emotion

Up for air. God, I hate these springs. Physically difficult and mentally stressful. One of those things you can't rush. Must just bull thought them.

20 June 2004

Focus
Manipulation
Emotion

Been thinking while I worked. Wonder what that is a sign of? Maybe it is becoming more automatic than earlier. Certainly less stress.

20 June 2230

Manipulation
Discontinuity

Compressed spring finished. What other springs need to be done? No first I should incorporate into section drawings....

20 June 2235

Manipulation

Now to incorporate into section drawings.

20 June 2240

Emotion
Computer

That was easy. Wow. Both springs. Computer are certainly a love/hate thing.

Manipulation
Emotion

Better start on the interlock spring while I'm in the mood to continue.

Emotion

What a flat feeling. Forward progress measured in microns.

20 June 2049

Focus

Just realized I hadn't saved in a long time. Don't remember when last time was. How did that happen? Could have been a big screw-up.

20 June 2120

Manipulation

Making progress on springs. Should save.....

20 June 2156

Focus
Discontinuity

Springs done and installed. Somehow I screwed up and deleted the spring development page before I saved it. Fortunately they were incorporated into the

Focus

Original drawing before I did it. Must be more careful. Pay more attention.

Emotion
Environment
Fatigue

Stressed about the test on Friday. Better get some sleep.

21 June 0600

Time Still need to print a couple to take with me to work on today...

Environment Then back to being a prisoner of this course.
Unfortunately it is so consuming that I can't get much else done.

21 June 0630

Focus Distracted. The spring problem also exists for the
Manipulation centerpost. Also need to make some changes to the cap thru-hole.

21 June 0650

Manipulation Made some changes to the cap and saved.

Focus Having trouble envisioning exactly how this would
Emotion work in a 360d. world, but somehow I know it will
Analysis work. Must give it some more thought.

21 June 0700

Concentration Emergency save. Lost in thought and need to get ready to go to class. Boy am I having fun.

21 June 0800

Time Back at it. Time is wasting. Maybe I can get a little
Manipulation done. It may be faster to compress the top section than make all the changes to the bottom.

21 June 0820

Privacy People keep stopping to look. Its distracting. I like
Environment having them around, but they can mind their own business.

21 June 0831

Environment
Concentration

Class is starting, better pack-up. Don't have a good appreciation of where I am. Couldn't keep the bubble.

21 June 0930

Emotion

Taking a break from this garbage. Not knowing where I stopped an hour ago, really corrupts the thought processes.

21 June 1300

Focus

Up and running after lunch. Still trying to get a handle on where I am.

21 June 1305

Focus
Manipulation

Got the bubble back. Going to work on making a new collapsed view.

21 June 1334

Concentration
Emotion
Time

Past time to quit. Lost track of time, even with all these people around. Feel driven to get this done. Running out of time.

Design

Made some changes to the fingerguard and interlock mechanism. Trying to incorporate all current progress onto this device.

Environment

Back to this silly class.

21 June 1826

Emotion	<u>I have been home for about an hour from that GD Bulls.....</u>
Environment	<u>Prisoner, a prisoner of a bunch of people who don't know S_____ from Shineola.</u>
Time	<u>I was up early this morning, 0530 or before, working on drawings....printing out a couple to take with me to</u>
Determination	<u>work on today....took the computer with me again today....worked at lunch time....</u>
Discontinuity	<u>Have a few problems to solve.....I'll be GD'ed....have a few problems to solve....now its just a matter of</u>
Fatigue	<u>making the drawings right.....Working tonight, for the third night in a row.....</u>

21 June 1924

Manipulation	<u>Saved some movement of the unterlock springs. Must incorporate them into the rest of the package.</u>
Design	<u>I must admit that they look better, perhaps less confusing, in their sectioned configuration.</u>

21 June 1946

Analysis	<u>I just discovered, during a check of interference fits, that the damn actuator ball is encroaching upon by the</u>
Emotion	<u>cam action of the bail pin.....Oh, Shit.....not a unsolvable problem, just a pain in the ass problem.</u>

21 June 1955

Link with Past Manipulation	<u>Went back to 6211334 and picked up top half and then split out the centerpost and pin assemblies.</u>

21 June 2020

Concentration	<u>Been trying to understand the apparent interference fit.</u>

Saved. Having trouble concentrating.

Focus

O.K., let's work it by the numbers. One step at a time.

21 June 2030

Momentum
Manipulation

Starting to come on-line. A little progress is contagious. If I can get one cap modified, then maybe I can transplant to the other.

21 June 2052

Emotion
Momentum

Caps away. One done, now lets see if I can make it two.

21 June 2114

Manipulation
Emotion

Need to make some changes to the Centerpost. This section thing is getting out of hand. It occurs to me that the spring guard and thru-pin are not correct for the PTO.

Emotion

Here I go again. Frustrated enthusiasm.

21 June 2133

Focus

Saved. Should have a long time ago. A lot of work at risk unnecessarily.

Manipulation

Finished the guard and retaining pin of one of the two views.

21 June 2145

Link with Past
Analysis

Went back to 6202049 and picked-up the centerpost actuator assembly. Just thinking.

21 June 2150

Focus

Time flew by. A quick 20 minutes. Saved changes to

Sample 7 Pg. 336

Manipulation	<u>screw threads, a mindless task, and completed modification of the fingerguard and retaining pin on the previously unchanged view.</u>
Analysis	<u>Still don't know why I went after the pin/spring drawings.</u>
Time Emotion	<u>Still feel pressured by course and PTO filing deadline.</u> 22 June 1240
Time Environment	<u>Only have about 20 minutes. Just finished getting something to eat, and class starts at 1300.</u>
Analysis	<u>I brought some drawings from the last few days, and need to mark-up areas that need attention.</u>
Link to Past Planning	<u>First, 6181544. To be correct as a section, I have got to add the sliced upper housing. Must figure how to deal with it obscuring the sole reason for the view.</u>
Link to Past Planning	<u>Next 6212150. Need to make separate pages for each of these views, and their corresponding counterparts.</u>
PTO Requirements	<u>Should both sections go on the same page? Yes.</u>
PTO Requirements	<u>Should front loaded and functioned views be on the same page? What about the loaded versus armed view?</u>
PTO Requirements Emotion	<u>Maybe the front and back of each view should be on a page. What's the criteria.....?</u>
Design Pride	<u>Also noticed some other technical errors. Most wouldn't be caught by the PTO, but I want them as correct as possible since they will be spending history with my name as draftsperson attached.</u>
Safety	<u>I should probably add some loaded/safed markings, just to keep the liability insurance happy.</u> <u>Think about the loading door. Does it need to be</u>

Function	<u>better defined?</u>
Time	<u>Whoops, better get back to class. Wouldn't want to be</u>
Environment	<u>late and have to talk with the principle.</u>

23 June 1110

Emotion	<u>I'm back. Just passed the silly test. With the</u>
Environment	<u>exception of a few minutes of escapism at lunch</u>
	<u>yesterday, I haven't given it any thought since night</u>
	<u>before last. Complete focus, and concern was getting</u>
	<u>past that ridiculous test.</u>

Focus	<u>Now lets see if I can get my head back together.</u>

Momentum	<u>Need some quick progress.</u>

23 June 1131

Manipulation	<u>Started identifying and assembling views for the PTO.</u>
Emotion	<u>Surprising how tough some of these decisions are.</u>

Analysis	<u>What needs to be shown, what is only nice to have,</u>
	<u>and what will get it thrown out.</u>

Emotion	<u>Its anybody's guess. The beauty of the American</u>
	<u>bureaucracy is its inconsistency.</u>

23 June 1253

Concentration	<u>Wow! I just lost an hour and 20 minutes. There was a</u>
Environment	<u>Jung interview playing in the background and people</u>
	<u>milling around, nobody paying particular attention to</u>
	<u>what I was doing.</u>

Emotion	<u>Stress is/was off. Let's see if I can reconstruct what</u>
	<u>occurred.</u>

Link with Past	<u>First. Went back and found 6141532. It provided</u>
	<u>front and back loaded, and top and bottom views.</u>

Planning
Manipulation

After I get home today, I'm going to try and sort out the sectioned views and a front and back of the expended device.

Enough for now. Should get back to class.

21 July 0926

Time

Up and running this morning. Hope to get a lot done.
The first of Aug is coming in a hurry.

21 July 0935

Uncertainty

Where to begin?!

Emotion

I'm really pleased with the progress to date. I should
be working on the specification....

Interruption

Phone.

21 July 0951

Uncertainty

Emotion

Don't know what to do next. Think about what needs
to be done. Need to do Something!

Uncertainty

Emotion

How am I going to explain this? What's important for
the PTO.....

21 July 0956

Focus

Uncertainty

Fatigue

Can't concentrate. What needs to be done?

Been a long week. I'm tried.

Focus

Let's see....

21 July 1006

Emotion

Enough already! Saved last night's work out of sheer
frustration. Can't get anything done. No focus.

21 July 1021

Uncertainty

Don't know what to do.

Uncertainty	<u>Don't know what needs to be done.</u>
Emotion	<u>Anxiety.</u>
Avoidance	<u>Perhaps do know what to do, just don't want to do it.</u>
Avoidance	<u>I have been resisting the naming and numbering process from the beginning. That's work I don't like to do. I can do it, but it's hard.</u>
Emotion	<u>Requires concentration. Hate to make mistakes....</u>
	21 July 1046
Avoidance	<u>Been screwing off. Looked at some previous drawings, stared out the window. Maybe I'll read my E-mail.</u>
	21 July 1100
Avoidance	<u>An hour wasted. Can't concentrate. Would rather be somewhere else, doing something else.</u>
Interruption	<u>Phone.</u>
	21 July 1109
Focus	<u>I'm back. I need to get into the groove.</u>
Visualization Escapism	<u>Maybe I'll think about the process by which this thing will function....that will be fun.</u>
	21 July 1125
Verbalization Privacy	<u>Just talked through the process by which this will function. If anyone heard me they will think I'm crazy.</u>
Visualization	<u>It took considerable time, I went over it several times in my head.....</u>

Time
Planning Wasn't complete waste of time, it will be beneficial
when I have to write the specification.

Interruption E-mail alarm just went off.

21 July 1145

Avoidance
Emotion I quit. Can't get anything done this morning. Maybe
I'll take a ride at lunch.

Avoidance
Emotion Enough already. Tired of beating myself up. Maybe
I'll work tonight.

22 July 2002

Time
Avoidance Saturday night. Didn't do anything all day. Weird
situation. Know it needs to be done, but can't bring
myself to deal with the pain of doing it.

22 July 2015

Time
Emotion Need to get at it. Stop fighting it.

22 July 2020

Avoidance I'll put on the T.V. Maybe that will help. New movie
tonight.

22 July 2030

Emotion Starting to calm down. Will stop fighting it soon. It
has to be done.

22 July 2036

Manipulation
Uncertainty
Time Alright. Baseline save. Where to begin? Aug first is
just around the corner.

22 July 2117

Analysis
PTO

In a blinding flash, it occurs to me that I don't have consistency between the drawings. That will drive the PTO crazy.

Link with Past

Centerpost is an example. I thought about it a couple of days ago, but never got around to fixing them all.

Fatigue

!I'm past tired, but...Onward

22 July 2130

Manipulation

Fixed the centerposts, now how about the appearance of the pin through hole. I'd better check it on the loaded sectioned view.

22 July 2139

Fixed and saved.

Fatigue

Feels more like 2330 than only 2130. Should quit. Too tired to do a good job.

22 July 2151

Focus

Looking at the first page. Safety save. Can't concentrate. Distracted.

Focus

What was I going to do next?

Focus
Fatigue

Hell, What did I just Do?

22 July 2159

Fatigue

Another save. So tired I can't see straight.

Focus

PTO. Think.

PTO
Link with Past

They complained last time about placement of some text. What was the problem?

Emotion	<u>Stressed.</u>
Emotion	<u>Their damn instruction are vague, subject to interpretation. Typical.</u>
Emotion	<u>Disgust, stress.</u>
22 July 2207	
Momentum	Another save. <u>Just wanted to do something.</u>
Computer	<u>Been playing with the text command. Strange process one must go through to make it work.</u>
Computer	<u>Almost crude when compared with other portions of the program.</u>
Computer	<u>Alternatives? Can the data be exported to a WP program?</u>
Discontinuity	<u>If I've got to number with this thing....</u>
Computer	<u>Run it through again?</u>
Discontinuity	<u>When I group a text item, all sorts of weird things happen...see....</u>
Analysis	<u>What are the implications for numbering?</u>
Fatigue	<u>Tired. Maybe I'm the one doing weird things.....don't think so.</u>
Computer Time	<u>If I've gotten to here and this doesn't work, I'm screwed. Timeline could go to the dogs.</u>
22 July 2220	
Computer	<u>Better go look for the software manual.</u>

22 July 2226

Fatigue

Found it! Going to quit for tonight. It will all make more sense in the morning.

23 July 1314

Environment

Managed to get a lot of sleep last night, and I've had a shower. Back to work. Mona and Ethan have gone to the mall. All's quiet.

Emotion

Feeling better.

I hate to do this....

I hate to rebuy real estate.

Screw-it, let's do it.

Uncertainty

Where should I start numbering. These are the decisions I have been putting off.

Uncertainty

I don't know where to start.

Analysis

At the top, and work down? Makes sense. At the bottom and work up? Equally sensible. If I go exterior to interior, at what point do I do the center....

Link with Past

I should remember this from last time....all I remember is that I hated it then as well.

Process

O.K. let's start somewhere...At the centerpost and move out.

Computer

Fired up both the drawing program and the Patent software. It has some interesting kinks, but is invaluable for on-line help with PTO specifics.

Computer

Computer is slowing down. Not enough memory to run both efficiently.

Computer	<u>O.K. I'll print a copy and number by hand, closing down the drawing package while I name the parts and then putting on the numbers later.</u>
Computer Emotion	<u>God, I hate inadequate computers.</u>
	23 July 1440
Momentum Computer	<u>Saved first attempt at numbering. Parts named in Patent software and numbered in drawing package.</u>
Emotion	<u>Works, but it isn't pretty.</u>
Momentum Emotion Computer	<u>Ten done. Wow! Process for drawing connecting lines is equally cumbersome. What was the PTO requirement on them?</u>
Link with Past	<u>Don't remember, better look it up. Something simple, but specific.</u>
Emotion Momentum	<u>Stress and frustration, combined with the pleasure of forward motion. Why doesn't anybody do this.</u>
	23 July 1453
Momentum	<u>Saved more progress. Seems to be making sense.</u>
Emotion	<u>I'm still stressed thought....</u>
Analysis	<u>Is it correct, more importantly, does it...will it, make sense when application time is at hand. Globally, have I missed anything?</u>
Emotion	<u>This text process is still a pain in the ass. Going to be a long haul to get it done.</u>
Analysis	<u>How am I going to check for mistakes?</u>
	23 July 1505
Emotion	<u>Save again. I'm scared to death of loosing some of</u>

this, and having to reconstruct. Don't think I could, would have to start over....

23 July 1535

Concentration
Momentum
Computer

Wow!, have I been on a roll. Don't know were the time has gone, Mona should be home soon. If the computer was been faster, I might have been able to do more.

Process

It isn't a pretty procedure, but I reduced it to repetitive process.

Emotion

Saved.

Can I, should I, Must I, have assemblies for the PTO. Stress! No wonder the public has begun to hate the Federal Government.

Wonder what it will be like if they eliminate the Commerce Department?.....Oh, well..

23 July 1611

Focus
Environment

More progress, unincumbered by perception of time. Wonder why Mona isn't home.

Emotion
Environment

Saved here. Beginning to love the complexity. On a roll. This would be easier if I had a clipboard and a light.

Environment

Need to build a light table. Used to have one, wonder what happened to it?

Analysis

All stop. Let's think this through....

Computer

How should I be using the layers? Just discovered (by accident) that I may not want the numbers and type to be the same density as everything else. Also might want to hide the numbers and connecting lines when printing.

Emotion	<u>Can't think of why, but might.....</u>
Concentration	<u>Never close a door.</u>
	23 July 1631
Focus	Better save. <u>Lost the big Mo...haven't gotten anything done for 20 minutes.</u> Onward!
	23 July 1701
Environment	Saved again. <u>No progress.</u> I found the PTO drawing manual, and then <u>Mona arrived.</u> <u>Wanted to show me what she bought, and I don't remember if I made any progress or not.</u> <u>I guess not.</u> <u>Hungry.</u>
Hunger	
Fatigue	<u>Tired of sitting here.</u>
Focus	<u>With a sense of progress, I'm tempted to blow off the remainder of the night.</u>
Emotion	<u>Better not.</u>
	23 July 1718
Momentum	<u>Back on track.</u> <u>Making progress.</u>
	23 July 1741
Momentum	Saved again. <u>Seems like I got a lot done.</u> I had
Manipulation	<u>changed drawings and started putting numbers on the loading view.</u> <u>Would have been faster, but I had to</u>
Process	<u>figure a process by which I would minimize screw-ups.</u> <u>Don't need to rebuy real estate.</u>
Emotion	<u>The detail and discipline are driving me INSANE!</u>
	23 July 1745
Emotion	<u>For some reason, I felt the urge to find and open all the pages of the PTO package.</u> <u>Don't know exactly why.</u> <u>Closed most without changes.</u>
Link with Past	

Process
Analysis Stopped numbering to add an additional view of the Grenade Pin. Still not right... Need to think about it. What I want to show is the Cam section...

Manipulation
Analysis
Emotion Numbering the fingerguard section...gee, it's nice to have a standard vocabulary. Wouldn't it have made the whole process easier? Never learn.

23 July 1811

Hungry Saved. Hungry. Food!

23 July 2000

Food
Environment
Momentum Had something to eat, and got Ethan ready for school tomorrow. Now let's see if I can find the groove.

23 July 2032

Momentum
Manipulation Let the numbers fly. Didn't take much effort to get back on the curve. Numbered and saved the actuator and pins. No changes to the last exploded view (can't think of the name....silly).

Emotion

Momentum A few connecting lines and these will be in bed.

24 July 1408

Momentum
Momentum

Let's see if I can get on the wagon here. Made a lot of progress yesterday, and typically have difficulty making progress the following day.

Manipulation
Emotion

Need to number. The stress, and frustration of doing so isn't diminished by yesterday's success.

24 July 1424

Manipulation
Avoidance

Made some minor changes to the hatching on the cap, and saved. Avoidance Craig. Come on!

Time

Running out of time today.

24 July 1500

Process
Emotion

Progress numbering. Working on both sections at once. Prescription for screw-up.

Manipulation

I wonder if numbers and connectors can be copied and applied?

24 July 1511

Manipulation

Saved. Need to work on layers and copying....

Interruption

Phone....

24 July 1600

Interruption
Momentum

Just returned from that rude interruption. Will try to get something....

Interruption

E-mail beep!

24 July 1644

Emotion
Environment

I had better save this thing before I loose it. Haven't gotten much done in the last hour. Better go get

Ethan. He must think I'm lost.

24 July 1852

Food

Home and fed.

Computer
Emotion
Time

Set-up the computer, let's see if I have any energy to make progress. Aug is just around the corner.

24 July 1936

Computer

Trying to capitalize on the copy command. May be loosing ground instead. All attempts to cut and paste the number from the compressed section to the extended section have ended in failure. Doesn't appear to be worth the trouble to paste and move the numbers.

24 July 1950

Emotion
Manipulation
Emotion

Saved in frustration. Added but a few numbers to the total package. One step forward....

24 July 2004

Emotion
Manipulation
Computer

Never say die!! Tried one more time, and met with limited success. More had the computer been faster.

Emotion

Put so much work into it, wanted to save it before something happened.

24 July 2020

Concentration
Fatigue
Time

Having trouble concentrating. Tired, and the end is in sight. Still, have a lot to do before 01Aug. May be a crash at the end.

24 July 2031

Loosing the bubble. Distracted by the TV. That

Sample 10 Pg. 351

Focus seldom happens. Maybe I should quit and get some sleep.

Environment

Fatigue

Emotion

Hell, I'd just like to read the newest computer magazine that are piling up in the corner.

24 July 2054

Manipulation

Fatigue

Time

Saved. Pushed some numbers around, not sure made any real forward progress. Physically tired, and tired of this. Next Monday, I've got to have this thing in the mail.

Think I'll quit.

26 July 0730

Emotion

Back at it. Yesterday was a Zoo!
Fill like raising a little Hell.

Design

PTO

As I look at this loading door view that I numbered yesterday, I wonder if the door itself is adequate for PTO purposes.

Design

PTO

Emotion

Since I can't add anything after it has been mailed, maybe I should do a front view of the door just to cover it.

Function

Safety

Will the door and the interlock handle function properly, or will the vector and friction cause them to hang-up?

26 July 0755

Momentum

Saved, as a function of building some momentum.

26 July 0803

Momentum

Design

Visualization

On a roll! Pulled off the door, and laid it down in an attempt to make a front view. It works, I think, but the drawing lines suggest parts that have yet to exist in

Sample 10 Pg. 352

my mind.

26 July 0817

Momentum
Emotion
Safety

Still at it. Not happy with the cam action of door and interlock handle. Door can be opened enough to insert a finger before safety interlock is engaged.

Emotion

Unacceptable.

Design

I have rounded the handle and am trying to determine shape of cam for door.

26 July 0841

Concentration
Design

Lost the last 20 minutes. First cam didn't work was well as I would have liked, so working on second style.

Design
Safety

Complex relationship between parts and "looks" or image of the device. Solution must first increase "safety" and second be visually pleasing.

26 July 0843

Function
Safety

It appears that no matter what configuration cam I develop, it will be inadequate to keep fingers out of the loading hole, thus presenting the potential for a crush injury should the device inadvertently collapse during loading.

26 July 0846

Linked to Past

Gone back to 7240830 and pick-up the top section view of the fingerguard.

Function
Safety

A cam on both sides of the door is the only way to prevent injury. For that to work, the balls must be properly aligned to provide space for the cam.

Function

I must go back and find the ball pattern, then overlay

Sample 10 Pg. 353

Safety Design	<u>with rotation to understand the limits, the interface with the ball cutters, and what will happen if a ball is perpendicular to the cam when the door is forced closed. Will it break??</u>
Marketability	<u>Objective is not to eliminate owner of grenade with a malfunction.</u>
	26 July 0902
Manipulation	<u>Took a while to find the ball pattern.</u>
Computer Emotion	<u>And even longer to rotate the damn things reliably.</u>
Momentum Time Emotion	<u>For some reason, I'm on a roll this morning and everything has to be done in a hurry.</u>
	26 July 0924
Interruption Manipulation	<u>After two phone calls, and some careful manipulation of the components, I have a drawing that outlines the most likely conditions that could exist with the ball,</u>
Function Visualization	<u>ballcutter and door combination.</u>

APPENDIX - M

VERBAL SAMPLE LABELS

Category	Label	Passage	Date/Time
Appearance	Design	.It would be real nice if the pattern of the void of the holes in this guard were as	31 May 0915
Appearance	Design	I'm pleased with the sect,	31 May 0915
Appearance	Design	It's workable, but doesn't "feel" right	31 May 1015
Appearance	Design	Has nice lines.	31 May 1931
Appearance	Design	Top half looks so good,	31 May 1946
Appearance	Design	Looking better. Faired the lines from this afternoon	31 May 2001
Appearance	Design	Look good	31 May 2017
Automation	Computer	Let's start rebuilding this puppy	31 May 1030
Automation	Manipulation	Trying to build this accurately	31 May 1034
Automation	Manipulation	Think I will draw it	31 May 1406
Automation	Manipulation	Picked-off the top and put it on a second page.	31 May 1446
Automation	Manipulation	Drew additional material (washer?) on bottom of cap.	31 May 1446
Automation	Manipulation	What I was doing was not developmental as much as it was manipulating of the	31 May 1750
Automation	Manipulation	Have pulled up this afternoon's drawings. Think I will clean it up a little. Curr	31 May 1924
Automation	Manipulation	After I got the centerpost removed I constructed an exterior view of the finger	31 May 1931
Emotional	Emotion	So much for that.....	30 May 2133
Emotional	Stress	wondering how I'm going to get anything of consequence accomplished in the	31 May 0915
Emotional	Emotion	Frustrated because I can't find a workable solution, yet	31 May 1012
Emotional	Emotion	Pleased with the visual.	31 May 1026
Emotional	Emotion	Still like the complexity of the spring.	31 May 1349
Emotional	Emotion	Anxiety.	31 May 2001
Environmental	Time	wondering how I'm going to get anything of consequence accomplished in the n	31 May 0915
Environmental	Privacy	people are looking at me, but they have no idea what I'm doing.	31 May 0945
Environmental	Time	For now, must go to meeting.	31 May 1446
Environmental	Privacy	enough said....here comes Mona and Ethan...	31 May 1750
Environmental	Time	That didn't take long.	31 May 1931
Intellectual	Visualization	the bail has got to swing out of the way	30 May 2133
Intellectual	Subsequent Thou	BFO, it occurs to me that I can't fix the bail,	30 May 2133
Intellectual	Visualization	That will help visualizing the slipping.	31 May 1030
Intellectual	Development Pro	labeling the parts, and starting to describe the mechanism	31 May 0921

Category	Label	Passage	Date/Time
Intellectual	Development Pro	process that I have been going through, this part development is concurrent...I	31 May 0921
Intellectual	Development Pro	Concentration here is easier than I expected.	31 May 0945
Intellectual	Privacy	Don't know why I'm so protective.	31 May 0951
Intellectual	Visualization	I keep envisioning a slide mechanism design functioning	31 May 1015
Intellectual	Visualization	Having trouble with transition from visual image to two dimensional represent	31 May 1026
Intellectual	Concentration	Commotion in here beginning to bother me. Can't concentrate	31 May 1034
Intellectual	Concentration	Think! damit!	31 May 1406
Intellectual	Concentration	Phone rang. Gotta get my thought processes back	31 May 1406
Operation	Function	I haven't really come to grips with the finger guard though	31 May 0915
Operation	Function	I'm going to have a difficult problem with dispersal...	31 May 0915
Operation	Safety	will preclude the insertion of fingers, or anything else that might do damage, in	31 May 0915
Operation	Function	the paint, once punctured, will start dispersing over the range of travel...top an	31 May 0915
Operation	Function	Actuation mechanism is bothering me.	31 May 1012
Operation	Function	It's workable, but doesn't "feel" right	31 May 1015
Operation	Function	BFO was stationary post, stationary cap, movable slipping mechanism.	31 May 1026
Operation	Function	Think about housing head interface	31 May 1034
Operation	Function	Slip ring with retaining pins	31 May 1406
Operation	Function	Configuration....Wear....., Materials.....Ferrous? Brass? Attachment?	31 May 1406
Operation	Function	How about an iris? The leaf shutter of a camera? No, the aperture of a lens. C	31 May 1406
Operation	Function	What are the necessary clearances between the shaft and cap ID?	31 May 1406
Operation	Function	If it was spring loaded, could it reset automatically when the device expanded??	31 May 1446
Operation	Function	How would the pin work with this arrangement?	31 May 1446
Operation	Function	Clearances...Alignment..	31 May 2001
Operation	Safety	Smashed fingers...how am I going to minimize the possibility?	31 May 2001
Operation	Function	Actuation still an outstanding issue	31 May 2017
Physical	Fatigue	Tired of sitting	31 May 2017

Category	Label	Passage	Date/Time
Appearance	Design	but I find myself wondering if other types of grenades might not also be ap	1 June 0900
Appearance	Design	it occurs to me all the problems I haven't solved.	1 June 0942
Appearance	Design	depicting a quartered as opposed to a bisected shell	1 June 1130
Appearance	Design	It is essential that they be oriented in such a way as to facilitate their positi	2 Jun 2058
Appearance	Design	that insert probably ought to have a troth that the balls roll in, and it proba	2 Jun 2058
Appearance	Design	The interfaces concern me. Tolerances....hum....	2 June 2045
Appearance	Design	Added a foot to the front and finished the interface. Looks like some type	2 June 2130
Appearance	Design	Screwed it up. Damn those clearances are going to be a consideration.	2 June 2216
Appearance	Design	They must be large enough to expell the paint before it passes the centerpi	2 June 2225
Appearance	Design	Let's look at the cap/top half interface from a different light...	3 June 0755
Automation	Manipulation	the execution of those issues is complicated by the complexity of designing	1 June 0900
Automation	Computer	using a technical drawing package for what should essentially be a CAD o	1 June 0900
Automation	Manipulation	Just started parts that would be necessary	1 June 2015
Automation	Manipulation	Better add a through hole for the centerpin.	1 June 2148
Automation	Manipulation	Refined groove in liner and added crude representation of centerpost	2 June 220
Automation	Manipulation	Alignment was tricky. Mouse acting funny. Things are jumping around	2 June 2045
Automation	Manipulation	I grouped the bottom pieces and moved them back.	2 June 2141
Automation	Computer	The computer is a savior and a pain in the ass.	2 June 2141
Automation	Manipulation	I'm not sure I ever realized how much effort was associated with it, and y	3 June 0630
Automation	Manipulation	I suspect the total time might be somewhat less, but the frustration is actua	3 June 0630
Automation	Computer	Particularly with the HP 4 at 600 DPI, I believe it will be more than adequ	3 June 0630
Automation	Computer	Maintenance of the computer, generation of disks, copying files, protecting	3 June 0630
Automation	Computer	I'm not sure I ever realized how much effort was associated with it, and y	3 June 0630
Automation	Manipulation	Redrawing the upper half	3 June 0811
Creativity	History	If I just let it run a normal course, I would suspend effort on this for a coup	1 June 0900
Creativity	Association	the mallets we used to use on the wooden handled chisels were similar	1 June 0900
Emotional	Pride	I have fought it in the past, trying to make specific deadlines for Patent fili	1 June 0900
Emotional	Conflict	I have fought it in the past, trying to make specific deadlines for Patent fili	1 June 0900
Emotional	Emotion	Appears to be almost abnormal, and I'm torn about fighting it, since I need	1 June 0900
Emotional	Motivation	Don't have much creative energy right at the moment....don't know why...	1 June 0900
Emotional	Emotion	progress I was making, and that gives me some enthusiasm	1 June 0926

Category	Label	Passage	Date/Time
Emotional	Emotion	it occurs to me all the problems I haven't solved.	1 June 0942
Emotional	Emotion	I'm still at this s	1 June 1130
Emotional	Emotion	Without stopping, I have been doing nothing but printing these puppies all	1 June 1345
Emotional	Emotion	Making some progress, finally	1 June 2015
Emotional	Emotion	but I like the growing complexity.	1 June 2045
Emotional	Emotion	Maybe the momentum can keep me going	1 June 2145
Emotional	Emotion	Go figure.	1 June 2155
Emotional	Emotion	Gotta get some sleep. Happy, frustrated, feeling of accomplishment, anticip	1 June 2200
Emotional	Emotion	Absolutely nothing done	2 June 2020
Emotional	Emotion	Just came up for air.	2 June 2110
Emotional	Emotion	Tried to quickly finish the centerpost	2 June 2216
Emotional	Emotion	Current version doesn't seem to have the visual impact of some of the earli	2 June 2225
Emotional	Emotion	Tired, discouraged, enthusiastic, excited, and apprehensive all at once	2 June 2225
Emotional	Emotion	Up and at it. Still tired but anxious to get to work. Kind of a flat expectati	3 June 0555
Emotional	Emotion	I suspect the total time might be somewhat less, but the frustration is actua	3 June 0630
Emotional	Emotion	Think I will put on the TV. Feeling lonely.	3 June 0740
Emotional	Emotion	Needed to to SOMETHING.	3 June 0751
Environment	Time	.how much time I'm going to have today remains to be seen	1 June 0926
Environment	Time	Getting late. Must quit	1 June 2155
Environment	Time	Just accomplished a lot in but a few minutes.	1 June 2155
Environment	Privacy	Mona will be in here so I probably won't say as much.	2 June 2020
Environment	Time	have spent huge amounts of time, literally huge amounts of time drawing,	3 June 0630
Environment	Time	I'm not sure I ever realized how much effort was associated with it, and y	3 June 0630
Environment	Time	I also spend quite a bit of time on maintenance	3 June 0630
Intellectual	Discontinuit	I'm not executing.....working those individually...	1 June 0900
Intellectual	Visualization	but what I haven't come to grips with, or what I haven't addressed yet is ho	1 June 0942
Intellectual	Visualization	or be displaced and as a result sharp pins to come out and puncture the ball	1 June 1009
Intellectual	Developmenta	Should they be field servicable	1 June 2145
Intellectual	Concentration	Looking forward to a weekend so I can get some things done.	1 June 2145
Intellectual	Developmenta	One last change. The holes though the fingergrasp. How large should the	1 June 2155
Intellectual	Developmenta	cap/upperhalf interface. Flush? Screwed? Glued? Pined?	1 June 2150

Category	Label	Passage	Date/Time
Intellectual	Decision Abey	For now I will just go the gross interface. Maybe time will provide insight	1 June 2150
Intellectual	Activity Rate	Not a word...Haven't even thought about this today	2 Jun 2020
Intellectual	Developmental	Put it in for thinking purposes. Nothing specific.	2 June 220
Intellectual	Design Process	Had to change the overall length some and the bottom half a little, but add	2 June 2110
Intellectual	Design Process	Have been modifying the interface between the finger guard and bottom half	2 June 2110
Intellectual	Visualization	Where does capsule go upon complete collapse?	2 June 2139
Intellectual	Design Process	Secured liner to bottom half	2 June 2139
Intellectual	Discontinuity	Will hold in place and...	2 June 2149
Intellectual	Attention	Been daydreaming. Must get back to work	2 June 2212
Intellectual	Reflection	Better get off the soapbox. Enough reflection already. Work to do.	3 June 0640
Intellectual	Attention	Zenned out. Must get back to work.	3 June 0707
Intellectual	Attention	Lost in thought	3 June 0740
Intellectual	Visualization	Need to think about the interface from the upper half's perspective, not that	3 June 0811
Intellectual	Perspective	Changed my perspective on the interface. Makes more sense now	3 June 0825
Intellectual	Discontinuity	I don't know how I know that, haven't thought it through	3 June 0825
Operation	Function	If I could build a potato masher with a CO2 cartridge in the handle, much t	1 June 0900
Operation	Function	to dispense the balls with a pneumatic as opposed to a mechanical function	1 June 0900
Operation	Function	thinking about other ways of accomplishing this particular mission.	1 June 0900
Operation	Function	problems associated with the design, the more challenging aspects of finish	1 June 0900
Operation	Marketability	to dispense the balls with a pneumatic as opposed to a mechanical function	1 June 0900
Operation	Function	problem with this offset functioning mechanism is the placement of the pin	1 June 0942
Operation	Function	its easy to build a ball cutter that is complex, it is difficult to build a ball cu	1 June 1009
Operation	Function	It may be some type of insert into the top, into the upper or lower troth, tha	1 June 1009
Operation	Function	Problems associated with that appear to be fairly few, other than buildup of	1 June 1009
Operation	Function	and look at the pin that I had designed to work with this particular configu	1 June 1009
Operation	Function	I guess what I'm saying is that the pin has to secure the relationship betwee	1 June 1009
Operation	Function	The idea being the paint dispersal would be closer to unidirectional	1 June 1130
Operation	Function	the finger guard might, could, should have openings that deflect the paint i	1 June 1130
Operation	Safety	embedded pins that are fairly blunt, so if somebody's finger got in there it	1 June 2015
Operation	Function	Confronted with the problem of how to pierce the balls....didn't know how	1 June 2015
Operation	Function	Process coming into focus	1 June 2045

Category	Label	Passage	Date/Time
Operation	Progress	Think I will screw the fingerguard mechanism to the upper half, then I can	1 June 2145
Operation	Servicability	What about the spring under compression even when it is at "rest?"	1 June 2145
Operation	Safety	What about the spring under compression even when it is at "rest?"	1 June 2145
Operation	Function	Needs to go through the center core and the fingergrasp.	1 June 2148
Operation	Producability	that my bottom half will have an insert to make it producible,	2 Jun 2058
Operation	Function	Drainage.	2 June 2130
Operation	Function	Interface with balls. How held in place?	2 June 2139
Operation	Function	Added drainholes in the liner and bottom half.	2 June 2225
Operation	Servicability	cap must be removable in order to disassemble and replace parts	3 June 0825
Physical	Fatigue	I was so tired, exhausted actually, that I didn't want to think about it.	1 June 0900
Physical	Fatigue	Fatigue. Mind is slowing down	1 June 2145
Physical	Fatigue	Been a long week	2 June 2225
Physical	Fatigue	Enough for tonight	2 June 2225

Category	Label	Passage	Date/Time
Appearance	Design	Bottom of core part is extremely weak. How many screws?	09 June 1522
Appearance	Design	Fingerguard portion was easy. Should this be the same material? What about s	09 June 1522
Appearance	Marketability	It's identical to the core washer. Fewer parts, less cost.	09 June 2005
Automation	Manipulation	Must extend the refinement of the core retaining screws to reflect the other scre	09 June 1430
Automation	Manipulation	Have started to explode the whole	09 June 1447
Automation	Computer	Must learn how to shade metal parts	09 June 1447
Automation	Manipulation	Saved centerpost and spring quickly came out.	09 June 1549
Automation	Manipulation	Lot of dimensioning complete, much left to do	09 June 1642
Automation	Manipulation	Moved things around and dimensioned the pin.	09 June 2029
Emotional	Emotion	I have kinda of a flat feeling about the project.	09 June 1430
Emotional	Emotion	Periodically I forget how easy it is to hate a computer.	09 June 1447
Emotional	Emotion	Hit the groove	09 June 1549
Emotional	Emotion	More time wasted. Saved in an attempt to accomplish SOMETHING!	09 June 1710
Emotional	Emotion	On a roll again. Rushed. Must continue.	09 June 1821
Emotional	Satisfaction	Don't think I've moved any muscles other than my mouse arm. Accomplished a	09 June 1821
Emotional	Emotion	Saved what little advancement I had done. Perhaps I should quit.	09 June 2005
Environmental	Environment	Sun is bright.	09 June 1430
Environmental	Time	that doesn't provide much progress toward the ultimate objective.	09 June 1430
Environmental	Time	Rushed.	09 June 1821
Intellectual	Uncertainty	More questions than answers.	09 June 1447
Intellectual	Concentration	I need to understand this thing.	09 June 1447
Intellectual	Uncertainty	What now?	09 June 1447
Intellectual	Concentration	Lost in the computer.	09 June 1642
Intellectual	Inattention	Been daydreaming. Nothing done.	09 June 1700
Intellectual	Inattention	Can't get it back.	09 June 1710
Intellectual	Concentration	Wow. Came up for air	09 June 1821
Intellectual	Discontinuity	Preoccupied I guess. Don't know if I can recap everything that....	09 June 1931
Intellectual	Preoccupation	Don't know why I didn't before.	09 June 1931
Intellectual	Inattention	Just sitting and staring at the screen	09 June 1945
Intellectual	Reasoning	Does this even make sense? What is it doing? Holding in the centerpin? No.	09 June 2005
Intellectual	Discontinuity	Must give this.....	09 June 2005

Category	Label	Passage	Date/Time
Intellectual	Link to Past	Went back to 6032243 and found a Pin.	09 June 2012
Physical	Fatigue	Sore. Stiff. Arm tired. Butt tired	09 June 1821
Physical	Fatigue	This certainly isn't rocket science, but It sure is tiring. Tomorrow is Saturday.	09 June 2029
Producability	Producability	If it isn't producible, then what is the point?!	09 June 1430
Producability	Producability	Drew the spring cavity with a truncated cone bottom, as it would be produced i	09 June 1515
Producability	Producability	Bottom would be cast with feet. Thur-drilled, Bottom machined core void?Cast	09 June 1549
Producability	Producability	It's identical to the core washer. Fewer parts, less cost.	09 June 2005

Category	Label	Passage	Date/Time
Automation	Computer	Computers are a pain in the A	10 June 0725
Automation	Computer	Had to learn how to rotate the screwhead so they would be in different positions.	10 June 0738
Automation	Manipulation	Dimensioned the Bail assembly.	10 June 0747
Automation	Manipulation	Brought the ball cutter forward.	10 June 0755
Emotional	Emotion	Must make some progress.	10 June 0650
Emotional	Emotion	It was a bear to draw, and the dotted line drove me nuts.	10 June 0738
Emotional	Emotion	Ball Cutters. Oh, Joy!	10 June 0747
Emotional	Emotion	Now must dimension. Booooooooooring!!	10 June 0755
Emotional	Momentum	Back on the progress trail.	10 June 0811
Emotional	Emotion	Time to get back to real work.	10 June 0811
Intellectual	Analysis	If I gave this page to someone, what would they not understand?	10 June 0650
Intellectual	Discontinuity	Drawing the front view wasn't easy, now how....	10 June 0708
Intellectual	Concentration	Drawing the front view wasn't easy, now how....	10 June 0708
Intellectual	Drawing Extrapolation	Started to work on the top view of the prototype bail assembly.	10 June 0708
Intellectual	Discontinuity	Why? Because...	10 June 0738
Intellectual	Searching	What else needs to be done?	10 June 0747
Intellectual	Link with Past	Must go back and find the PTO drawings	10 June 0811

Category	Label	Passage	Date/Time
Automation	Manipulation	What other springs need to be done?	20 June 223
Automation	Manipulation	Now to incorporate into section drawings	20 June 223
Automation	Manipulation	Better start on the interlock spring while I'm in the mood to continue.	20 June 224
Automation	Computer	Computer are certainly a love/hate thing.	20 June 224
Automation	Manipulation	The major problems have been solved, now it is just a matter of the bull work.	20 June 183
Automation	Manipulation	Making progress on springs. Should save....	20 June 212
Automation	Computer	Can't simply isolate and change the lines, must be redrawn with solid arcs and exten	20 June 1300
Automation	Manipulation	Can't simply isolate and change the lines, must be redrawn with solid arcs and exten	20 June 1300
Automation	Computer	Have I complained about computers lately?	20 June 1300
Automation	Manipulation	One down, one to go. Must do a second for the compressed view.	20 June 1312
Automation	Manipulation	Duplicated the Spring.	20 June 1322
Automation	Manipulation	Finished compiling the various parts. Surprising how difficult it is to decide what par	20 June 1845
Automation	Manipulation	Maybe it is becoming more automatic than earlier.	20 June 2004
Emotional	Emotion	Up for air. God, I hate these springs. Physically difficult and mentally stressful. One	20 June 194
Emotional	Emotion	Better start on the interlock spring while I'm in the mood to continue.	20 June 224
Emotional	Emotion	What a flat feeling. Forward progress measured in microns.	20 June 224
Emotional	Emotion	That was easy. Wow. Both springs.	20 June 224
Emotional	Emotion	Stressed about the test on Friday. Better get some sleep.	20 June 215
Emotional	Discipline	Back to work	20 June 1244
Emotional	Emotion	Couldn't describe the experience for the life of me. Can only be expressed as an emoti	20 June 1244
Emotional	Emotion	Perhaps a combination of anxiety, anxiousness and frustration, all wrapped into one.	20 June 1244
Emotional	Emotion	Hell.	20 June 1244
Emotional	Emotion	Can't simply isolate and change the lines, must be redrawn with solid arcs and exten	20 June 1300
Emotional	Emotion	Can't concentrate much with people around who want to talk.	20 June 1312
Emotional	Emotion	Must do something.	20 June 1320
Emotional	Momentum	Back to work	20 June 1322
Emotional	Achievement	Finished compiling the various parts. Surprising how difficult it is to decide what par	20 June 1845
Emotional	Emotion	The king of springs strikes again.	20 June 1910
Emotional	Discipline	Back to the spring again.	20 June 1910
Emotional	Emotion	Certainly less stress	20 June 2004
Environmental	Environment	Stressed about the test on Friday. Better get some sleep.	20 June 215

Category	Label	Passage	Date/Time
Environmental	Environment	Can't concentrate much with people around who want to talk.	20 June 1312
Environmental	Time	Little perception of progress for such a large consumption of time.	20 June 1312
Environmental	Environment	Lunch over, must pack up.	20 June 1330
Intellectual	Focus	Just realized I hadn't saved in a long time. Don't remember when last time was. How	20 June 204
Intellectual	Discontinuity	No first I should incorporate into section drawings....	20 June 223
Intellectual	Focus	Original drawing before I did it. Must be more careful. Pay more attention.	20 June 215
Intellectual	Discontinuity	Fortunately they were incorporated into the	20 June 215
Intellectual	Focus	Somehow I screwed up and deleted the spring development page before I saved it.	20 June 215
Intellectual	Contemplation	Just been sitting here thinking about this. Nothing in particular, just 4 or 5 interwove	20 June 1244
Intellectual	Analysis	In a BFO, I realized that if this were a true section, the front of the spring wouldn't b	20 June 1244
Intellectual	Concentration	Zened out.	20 June 1320
Intellectual	Link with Past	Went back to 6192244 for material.	20 June 1815
Intellectual	Focus	Been thinking while I worked.	20 June 2004
Physical	Fatigue	Up for air. God, I hate these springs. Physically difficult and mentally stressful. One	20 June 194
Physical	Fatigue	Stressed about the test on Friday. Better get some sleep.	20 June 215
Physical	Fatigue	Exhausted. Physically and emotionally hard work.	20 June 1312

Category	Label	Passage	Date/Time
Appearance	Design	Made some changes to the fingerguard and interlock mechanism. Trying to incorp	21 June 133
Automation	Manipulation	Also need to make some changes to the cap thru-hole.	21 June 063
Automation	Manipulation	Made some changes to the cap and saved.	21 June 065
Automation	Manipulation	It may be faster to compress the top section than make all the changes to the bolto	21 June 080
Automation	Manipulation	Going to work on making a new collapsed view.	21 June 130
Emotional	Emotion	Having trouble envisioning exactly how this would work in a 360d. world, but som	21 June 065
Emotional	Emotion	Taking a break from this garbage. Not knowing where I stopped an hour ago, real	21 June 093
Emotional	Emotion	Feel driven to get this done.	21 June 133
Environmental	Environment	Then back to being a prisoner of this course. Unfortunately it is so consuming that	21 June 060
Environmental	Time	Still need to print a couple to take with me to work on today...	21 June 060
Environmental	Time	Time is wasting.	21 June 080
Environmental	Environment	I like having them around, but they can mind their own business	21 June 082
Environmental	Environment	Class is starting, better pack-up.	21 June 083
Environmental	Environment	Back to this silly class.	21 June 133
Environmental	Time	Running out of time.	21 June 133
Intellectual	Focus	Distracted. The spring problem also exists for the centerpost	21 June 063
Intellectual	Analysis	Must give it some more thought.	21 June 065
Intellectual	Focus	Having trouble envisioning exactly how this would work in a 360d. world	21 June 065
Intellectual	Concentration	Lost in thought and need to get ready to go to class.	21 June 070
Intellectual	Privacy	People keep stopping to look. Its distracting.	21 June 082
Intellectual	Concentration	Don't have a good appreciation of where I am. Couldn't keep the bubble.	21 June 083
Intellectual	Focus	Up and running after lunch. Still trying to get a handle on where I am.	21 June 130
Intellectual	Focus	Got the bubble back.	21 June 130
Intellectual	Concentration	Past time to quit. Lost track of time, even with all these people around.	21 June 133

Category	Label	Passage	Date/Time
Appearance	Design	I must admit that they look better, perhaps less confusing, in their sectioned configuration.	21 June 1924
Appearance	Design	Also noticed some other technical errors.	22 June 1240
Automation	Manipulation	Saved some movement of the unterlock springs. Must incorporate them into the rest of the pac	21 June 1924
Automation	Manipulation	Went back to 6211334 and picked up top half and then split out the centerpost and pin assembly	21 June 1955
Automation	Manipulation	If I can get one cap modified, then maybe I can transplant to the other.	21 June 2030
Automation	Manipulation	Need to make some changes to the Centerpost.	21 June 2114
Automation	Manipulation	Finished the guard and retaining pin of one of the two views	21 June 2133
Automation	Manipulation	Saved changes to screw threads, a mindless task, and completed modification of the finger guard	21 June 2150
Automation	Manipulation	Started identifying and assembling views for the PTO. Surprising how tough some of these dec	23 June 1131
Automation	Manipulation	After I get home today, I'm going to try and sort out the sectioned views and a front and back of	23 June 1253
Bureaucracy	PTO Require	Maybe the front and back of each view should be on a page.	22 June 1240
Bureaucracy	PTO Require	Should both sections go on the same page? Yes.	22 June 1240
Bureaucracy	PTO Require	Should front loaded and functioned views be on the same page? What about he loaded verses a	22 June 1240
Emotional	Determination	...took the computer with me again today....worked at lunch time....	21 June 182
Emotional	Emotion	I have been home for about an hour from that GD Bulls	21 June 182
Emotional	Emotion	Oh, Shit.....not a unsolvable problem, just a pain in the ass problem.	21 June 194
Emotional	Momentum	Starting to come on-line. A little progress is contagious.	21 June 2030
Emotional	Emotion	Caps away.	21 June 2052
Emotional	Momentum	One done, now lets see if I can make it two.	21 June 2052
Emotional	Emotion	This section thing is getting out of hand. It occurs to me that the spring guard and thru-pin are	21 June 2114
Emotional	Emotion	Here I go again. Frustrated enthusiasm.	21 June 2114
Emotional	Emotion	Still feel pressured by course and PTO filing deadline.	21 June 2150
Emotional	Pride	Most wouldn't be caught by the PTO, but I want them as correct as possible since they will be	22 June 1240
Emotional	Emotion	What's the criteria.....?	22 June 1240
Emotional	Emotion	I'm back. Just passed the silly test. With the exception of a few minutes of escapism at lunch y	23 June 1110
Emotional	Momentum	Need some quick progress.	23 June 1110
Emotional	Emotion	Started identifying and assembling views for the PTO. Surprising how tough some of these dec	23 June 1131
Emotional	Emotion	Its anybody's guess. The beauty of the American bureaucracy is its inconsistency.	23 June 1131
Emotional	Emotion	Stress is/was off. Let's see if I can reconstruct what occurred.	23 June 1253
Environment	Time	I was up early this morning, 0530 or before, working on drawings....	21 June 182
Environment	Environment	Prisoner, a prisoner of a bunch of people who don't know S from Shineola.	21 June 182

Category	Label	Passage	Date/Time
Environment	Time	Still feel pressured by course and PTO filing deadline.	21 June 2150
Environment	Environment	Wouldn't want to be late and have to talk with the principle.	22 June 1240
Environment	Environment	Only have about 20 minutes. Just finished getting something to eat, and class starts at 1300.	22 June 1240
Environment	Time	Only have about 20 minutes. Just finished getting something to eat, and class starts at 1300.	22 June 1240
Environment	Time	Whoops, better get back to class.	22 June 1240
Environment	Environment	I'm back. Just passed the silly test. With the exception of a few minutes of escapism at lunch y	23 June 1110
Environment	Environment	There was a .Jung interview playing in the background and people milling around, nobody payi	23 June 1253
Intellectual	Discontinuity	[Have a few problems to solve.....I'll be GD'ed....have a few problems to solve....now its just a m	21 June 182
Intellectual	Analysis	just discovered, during a check of interference fits, that the damn actuator ball is encroaching u	21 June 194
Intellectual	Link with Past	Went back to 6211334 and picked up top half and then split out the centerpost and pin assembli	21 June 1955
Intellectual	Focus	O.K., let's work it by the numbers. One step at a time.	21 June 2020
Intellectual	Concentration	Been trying to understand the apparent interference fit. Saved. Having trouble concentrating.	21 June 2020
Intellectual	Focus	Saved. Should have a long time ago. A lot of work at risk unnecessarily.	21 June 2133
Intellectual	Link with Past	Went back to 6202049 and picked-up the centerpost actuator assembly. Just thinking.	21 June 2145
Intellectual	Analysis	Went back to 6202049 and picked-up the centerpost actuator assembly. Just thinking.	21 June 2145
Intellectual	Focus	Time flew by. A quick 20 minutes.	21 June 2150
Intellectual	Analysis	Still don't know why I went after the pin/spring drawings.	21 June 2150
Intellectual	Analysis	I brought some drawings from the last few days, and need to mark-up areas that need attention.	22 June 1240
Intellectual	Link to Past	Next 6212150. Need to make separate pages for each of these views, and their corresponding c	22 June 1240
Intellectual	Planning	First, 6181544. To be correct as a section, I have got to add the sliced upper housing. Must fig	22 June 1240
Intellectual	Link to Past	First, 6181544. To be correct as a section, I have got to add the sliced upper housing. Must fig	22 June 1240
Intellectual	Planning	Next 6212150. Need to make separate pages for each of these views, and their corresponding c	22 June 1240
Intellectual	Focus	Now lets see if I can get my head back together.	23 June 1110
Intellectual	Analysis		23 June 1131
Intellectual	Concentration	Wow! I just lost an hour and 20 minutes.	23 June 1253
Intellectual	Link with Past	First. Went back and found 6141532. It provided front and back loaded, and top and bottom vi	23 June 1253
Intellectual	Planning	After I get home today, I'm going to try and sort out the sectioned views and a front and back of	23 June 1253
Operation	Function	Think about the loading door. Does it need to be better defined?	22 June 1240
Operation	Safety	I should probably add some loaded/safed markings, just to keep the liability insurance happy.	22 June 1240
Physical	Fatigue	Working tonight, for the third night in a row.....	21 June 182

Category	Label	Passage	Date/Time
Automation	Manipulation	Alright. Baseline save	22 July 2036
Emotional	Uncertainty	Where to begin?	22 July 2036
Emotional	Emotion	Starting to calm down. Will stop fighting it soon. It has to be done.	22 July 2030
Emotional	Emotion	Need to get at it. Stop fighting it.	22 July 2015
Emotional	Emotion	I quit. Can't get anything done this morning. Maybe I'll take a ride at lunch.	21 July 1145
Emotional	Emotion	Enough already. Tired of beating myself up. Maybe I'll work tonight.	21 July 1145
Emotional	Escapism	Maybe I'll think about the process by which this thing will function....that will be fun.	21 July 1109
Emotional	Uncertainty	Don't know what needs to be done.	21 July 1021
Emotional	Emotion	Anxiety.	21 July 1021
Emotional	Uncertainty		21 July 1021
Emotional	Emotion	Requires concentration. Hate to make mistakes....	21 July 1021
Emotional	Emotion	Enough already! Saved last night's work out of sheer frustration. Can't get anything done	21 July 1006
Emotional	Uncertainty	What needs to be done?	21 July 0956
Emotional	Uncertainty	Don't know what to do next. Think about what needs to be done.	21 July 0951
Emotional	Emotion	What's important for the PTO.....	21 July 0951
Emotional	Uncertainty	How am I going to explain this?	21 July 0951
Emotional	Emotion	Need to do Something!	21 July 0951
Emotional	Uncertainty	Where to begin?!	21 July 0935
Emotional	Emotion	I'm really pleased with the progress to date. I should be working on the specification....	21 July 0935
Environmental	Time	Aug first is just around the corner.	22 July 2036
Environmental	Time	Need to get at it. Stop fighting it.	22 July 2015
Environmental	Time	Saturday night. Didn't do anything all day. Weird situation. Know it needs to be done,	22 July 2002
Environmental	Time	Wasn't complete waste of time, it will be beneficial when I have to write the specification	21 July 1125
Environmental	Interruption	E-mail alarm just went off.	21 July 1125
Environmental	Interruption	Phone	21 July 1100
Environmental	Interruption	Phone.	21 July 0935
Environmental	Time	Hope to get a lot done. The first of Aug is coming in a hurry.	21 July 0926
Intellectual	Avoidance	I'll put on the T.V. Maybe that will help. New movie tonight.	22 July 2020
Intellectual	Avoidance	Saturday night. Didn't do anything all day. Weird situation. Know it needs to be done,	22 July 2002
Intellectual	Avoidance	I quit. Can't get anything done this morning. Maybe I'll take a ride at lunch.	21 July 1145

Category	Label	Passage	Date/Time
Intellectual	Avoidance	Enough already. Tired of beating myself up. Maybe I'll work tonight.	21 July 1145
Intellectual	Visualizatio	It took considerable time, I went over it several times in my head.....	21 July 1125
Intellectual	Planning	Wasn't complete waste of time, it will be beneficial when I have to write the specification	21 July 1125
Intellectual	Verbalizatio	Just talked through the process by which this will function.	21 July 1125
Intellectual	Focus	I'm back. I need to get into the groove.	21 July 1109
Intellectual	Visualizatio	Maybe I'll think about the process by which this thing will function....that will be fun.	21 July 1109
Intellectual	Avoidance	An hour wasted. Can't concentrate. Would rather be somewhere else, doing something	21 July 1100
Intellectual	Avoidance	Been screwing off. Looked at some previous drawings, stared out the window. Maybe I'	21 July 1046
Intellectual	Avoidance	Perhaps do know what to do, just don't want to do it.	21 July 1021
Intellectual	Avoidance	I have been resisting the naming and numbering process from the beginning. That's wor	21 July 1021
Intellectual	Focus	Can't concentrate.	21 July 0956
Intellectual	Focus	Let's see....	21 July 0956
Intellectual	Privacy	If anyone heard me they will think I'm crazy.	21 July 1125
Physical	Fatigue	Been a long week. I'm tried.	21 July 0956

Category	Label	Passage	Date/Time
Appearance	Process	O.K. let's start somewhere...At the centerpost and move out.	23 July 1314
Appearance	Process	It isn't a pretty procedure, but I reduced it to repetitive process.	23 July 1535
Appearance	Process	Would have been faster, but I had to figure a process by which I would minimize screw-ups.	23 July 1741
Appearance	Process	Stopped numbering to add an additional view of the Grenade Pin.	23 July 1800
Automation	Manipulation	Fixed the centerposts, now how about the appearance of the pin through hole.	22 July 2130
Automation	Computer	Run it through again?	22 July 2207
Automation	Computer	Alternatives? Can the data be exported to a WP program?	22 July 2207
Automation	Computer	Almost crude when compared with other portions of the program.	22 July 2207
Automation	Computer	Been playing with the text command. Strange process one must go through to make it work.	22 July 2207
Automation	Computer	If I've gotten to here and this doesn't work, I'm screwed.	22 July 2207
Automation	Computer	Better go look for the software manual.	22 July 2220
Automation	Computer	God, I hate inadequate computers.	23 July 1314
Automation	Computer	O.K. I'll print a copy and number by hand, closing down the drawing package while I name the	23 July 1314
Automation	Computer	Computer is slowing down. Not enough memory to run both efficiently.	23 July 1314
Automation	Computer	Fired up both the drawing program and the Patent software. It has some interesting kinks, but i	23 July 1314
Automation	Computer	Ten done. Wow! Process for drawing connecting lines is equally cumbersome. What was the	23 July 1440
Automation	Computer	Saved first attempt at numbering. Parts named in Patent software and numbered in drawing pa	23 July 1440
Automation	Computer	If the computer was been faster, I might have been able to do more.	23 July 1535
Automation	Computer	How should I be using the layers? Just discovered (by accident) that I may not want the numbe	23 July 1611
Automation	Manipulation	changed drawings and started putting numbers on the loading view.	23 July 1741
Automation	Manipulation	Numbering the fingerguard section...	23 July 1800
Automation	Manipulation	Numbered and saved the actuator and pins. No changes to the last exploded view (can't think	23 July 2032
Bureaucracy	PTO	That will drive the PTO crazy.	22 July 2117
Bureaucracy	PTO	Their damn instruction are vague, subject to interpretation. Typical	22 July 2159
Emotional	Emotion	Stressed.	22 July 2159
Emotional	Emotion	Their damn instruction are vague, subject to interpretation. Typical.	22 July 2159
Emotional	Emotion	Disgust, stress.	22 July 2159
Emotional	Momentum	Just wanted to do something.	22 July 2207
Emotional	Emotion	Feeling better. I hate to do this....I hate to rebuy real estate. Screw-it, let's do it.	23 July 1314
Emotional	Emotion	God, I hate inadequate computers.	23 July 1314
Emotional	Uncertainty	Where should I start numbering. These are the decisions I have been putting off.	23 July 1314

Category	Label	Passage	Date/Time
Emotional	Uncertainty	I don't know where to start.	23 July 1314
Emotional	Momentum	Saved first attempt at numbering. Parts named in Patent software and numbered in drawing package.	23 July 1440
Emotional	Emotion	Works, but it isn't pretty.	23 July 1440
Emotional	Momentum	Ten done. Wow! Process for drawing connecting lines is equally cumbersome. What was the	23 July 1440
Emotional	Emotion	Ten done. Wow! Process for drawing connecting lines is equally cumbersome. What was the	23 July 1440
Emotional	Emotion	Stress and frustration, combined with the pleasure of forward motion. Why doesn't anybody d	23 July 1440
Emotional	Momentum	Stress and frustration, combined with the pleasure of forward motion. Why doesn't anybody d	23 July 1440
Emotional	Emotion	This text process is still a pain in the ass. Going to be a long haul to get it done.	23 July 1453
Emotional	Emotion	I'm still stressed thought....	23 July 1453
Emotional	Momentum	Seems to be making sense.	23 July 1453
Emotional	Emotion	I'm scared to death of losing some of this, and having to reconstruct. Don't think I could, would	23 July 1505
Emotional	Momentum	Wow!, have I been on a roll. Don't know where the time has gone, Mona should be home soon.	23 July 1535
Emotional	Emotion	Can I, should I, Must I, have assemblies for the PTO. Stress! No wonder the public has begun	23 July 1535
Emotional	Emotion	Can't think of why, but might.... Never close a door.	23 July 1611
Emotional	Emotion	Beginning to love the complexity. On a roll	23 July 1611
Emotional	Emotion	With a sense of progress, I'm tempted to blow off the remainder of the night. Better not.	23 July 1701
Emotional	Momentum	Back on track. Making progress.	23 July 1718
Emotional	Emotion	The detail and discipline are driving me INSANE!	23 July 1741
Emotional	Momentum	Seems like I got a lot done.	23 July 1741
Emotional	Emotion	Don't need to rebuy real estate.	23 July 1741
Emotional	Emotion	gee, it's nice to have a standard vocabulary. Wouldn't it have made the whole process easier?	23 July 1800
Emotional	Momentum	Now let's see if I can find the groove.	23 July 2000
Emotional	Momentum	Let the numbers fly. Didn't take much effort to get back on the curve.	23 July 2032
Emotional	Emotion	Numbered and saved the actuator and pins. No changes to the last exploded view (can't think	23 July 2032
Emotional	Momentum	A few connecting lines and these will be in bed.	23 July 2032
Environmenta	Time	Timeline could go to the dogs.	22 July 2207
Environmenta	Environment	Mona and Ethan have gone to the mall. All's quiet.	23 July 1314
Environmenta	Environment	Need to build a light table. Used to have one, wonder what happened to it?	23 July 1611
Environmenta	Environment	This would be easier if I had a clipboard and a light.	23 July 1611
Environmenta	Environment	Wonder why Mona isn't home.	23 July 1611
Environmenta	Environment	Mona arrived. Wanted to show me what she bought, and I don't remember if I made any progr	23 July 1701

Category	Label	Passage	Date/Time
Environmental	Environment	got Ethan ready for school tomorrow.	23 July 2000
Intellectual	Link with Pa	Centerpost is an example. I thought about it a couple of days ago, but never got around to fixin	22 July 2117
Intellectual	Analysis	In a blinding flash, it occurs to me that I don't have consistency between the drawings.	22 July 2117
Intellectual	Focus	Hell, What did I just Do?	22 July 2151
Intellectual	Focus	What was I going to do next?	22 July 2151
Intellectual	Focus	Looking at the first page. Safety save. Can't concentrate. Distracted.	22 July 2151
Intellectual	Link with Pa	Their damn instruction are vague, subject to interpretation. Typical	22 July 2159
Intellectual	Focus	PTO. Think.	22 July 2159
Intellectual	Analysis	What are the implications for numbering?	22 July 2207
Intellectual	Discontinuit	If I've got to number with this thing....	22 July 2207
Intellectual	Discontinuit	When I group a text item, all sorts of weird things happen....see....	22 July 2207
Intellectual	Analysis	At the top, and work down? Makes sense. At the bottom and work up? Equally sensible. If I	23 July 1314
Intellectual	Link with Pa	I should remember this from last time.....all I remember is that I hated it then as well.	23 July 1314
Intellectual	Link with Pa	Don't remember, better look it up. Something simple, but specific.	23 July 1440
Intellectual	Analysis	Is it correct, more importantly, does it...will it, make sense when application time is at hand. G	23 July 1453
Intellectual	Analysis	How am I going to check for mistakes?	23 July 1453
Intellectual	Concentratio	Wow!, have I been on a roll. Don't know were the time has gone, Mona should be home soon.	23 July 1535
Intellectual	Focus	More progress, unincumbered by perception of time.	23 July 1611
Intellectual	Analysis	All stop. Let's think this through.....	23 July 1611
Intellectual	Concentratio	Lost the big Mo...haven't gotten anything done for 20 minutes.	23 July 1631
Intellectual	Focus	No progress.	23 July 1701
Intellectual	Focus	With a sense of progress, I'm tempted to blow off the remainder of the night. Better not.	23 July 1701
Intellectual	Link with Pa	For some reason, I felt the urge to find and open all the pages of the PTO package. Don't know	23 July 1745
Intellectual	Analysis	Still not right... Need to think about it. What I want to show is the Cam section...	23 July 1800
Intellectual	Analysis	gee, it's nice to have a standard vocabulary. Wouldn't it have made the whole process easier?	23 July 1800
Physical	Fatigue	!I'm past tired, but...Onward	22 July 2117
Physical	Fatigue	Feels more like 2330 than only 2130. Should quit. Too tired to do a good job.	22 July 2139
Physical	Fatigue	Hell, What did I just Do?	22 July 2151
Physical	Fatigue	Another save. So tired I can't see straight.	22 July 2159
Physical	Fatigue	Tired. Maybe I'm the one doing weird things.....don't think so.	22 July 2207
Physical	Fatigue	Found it! Going to quit for tonight. It will all make more sense in the morning.	22 July 2226

Category	Label	Passage	Date/Time
Physical	Fatigue	Tired of sitting here.	23 July 1701
Physical	Hunger	Hungry	23 July 1701
Physical	Hungry	Saved. Hungry. Food!	23 July 1811
Physical	Food	Had something to eat,	23 July 2000

Category	Label	Passage	Date/Time
Appearance	Design	As I look at this loading door view that I numbered yesterday, I wonder if the door itself is	26 July 0730
Appearance	Design	Since I can't add anything after it has been mailed, maybe I should do a front view of the	26 July 0730
Appearance	Design	Pulled off the door, and laid it down in an attempt to make a front view.	26 July 0803
Appearance	Design	I have rounded the handle and am trying to determine shape of cam for door.	26 July 0817
Appearance	Design	Complex relationship between parts and "looks" or image of the device. Solution must fir	26 July 0841
Appearance	Design	First cam didn't work as well as I would have liked, so working on second style.	26 July 0841
Appearance	Marketability	Objective is not to eliminate owner of grenade with a malfunction	26 July 0846
Appearance	Design	I must go back and find the ball pattern, then overlay with rotation to understand the limit	26 July 0846
Automation	Manipulation	Need to number.	24 July 1408
Automation	Manipulation	Made some minor changes to the hatching on the cap, and saved.	24 July 1424
Automation	Manipulation	I wonder if numbers and connectors can be copied and applied?	24 July 1500
Automation	Manipulation	Need to work on layers and copying	24 July 1511
Automation	Computer	Set-up the computer.	24 July 1852
Automation	Computer	Doesn't appear to be worth the trouble to paste and move the numbers.	24 July 1936
Automation	Computer	Trying to capitalize on the copy command. May be loosing ground instead. All attempts	24 July 1936
Automation	Manipulation	Added but a few numbers to the total package.	24 July 1950
Automation	Computer	More had the computer been faster.	24 July 2004
Automation	Manipulation	Tried one more time, and met with limited success.	24 July 2004
Automation	Manipulation	Pushed some numbers around, not sure made any real forward progress.	24 July 2054
Automation	Manipulation	Took a while to find the ball pattern.	26 July 0902
Automation	Computer	And even longer to rotate the damn things reliably.	26 July 0902
Automation	Manipulation	some careful manipulation of the components	26 July 0924
Bureaucracy	PTO	As I look at this loading door view that I numbered yesterday, I wonder if the door itself is	26 July 0730
Bureaucracy	PTO	Since I can't add anything after it has been mailed, maybe I should do a front view of the	26 July 0730
Emotional	Emotion	Hell, I'd just like to read the newest computer magazine that are piling up in the corner.	24 July 2031
Emotional	Emotion	The stress, and frustration of doing so isn't diminished by yesterday's success.	24 July 1408
Emotional	Momentum	Made a lot of progress yesterday, and typically have difficulty making progress the followi	24 July 1408
Emotional	Momentum	Let's see if I can get on the wagon here.	24 July 1408
Emotional	Avoidance	Avoidance Craig. Come on!	24 July 1424
Emotional	Emotion	Prescription for screw-up.	24 July 1500
Emotional	Momentum	Will try to get something....	24 July 1600

Category	Label	Passage	Date/Time
Emotional	Emotion	Haven't gotten much done in the last hour.	24 July 1644
Emotional	Emotion	let's see if I have any energy to make progress.	24 July 1852
Emotional	Emotion	One step forward....	24 July 1950
Emotional	Emotion	Saved in frustration.	24 July 1950
Emotional	Emotion	Never say die!!	24 July 2004
Emotional	Emotion	Put so much work into it, wanted to save it before something happened.	24 July 2004
Emotional	Emotion	Back at it. Yesterday was a Zoo!	26 July 0730
Emotional	Emotion	Since I can't add anything after it has been mailed, maybe I should do a front view of the	26 July 0730
Emotional	Momentum	Saved, as a function of building some momentum.	26 July 0755
Emotional	Visualization	It works, I think, but the drawing lines suggest parts that have yet to exist in my mind.	26 July 0803
Emotional	Momentum	On a roll!	26 July 0803
Emotional	Emotion	Unacceptable.	26 July 0817
Emotional	Momentum	Still at it.	26 July 0817
Emotional	Emotion	Not happy with the cam action of door and interlock handle.	26 July 0817
Emotional	Emotion	For some reason, I'm on a roll this morning and everything has to be done in a hurry.	26 July 0902
Emotional	Momentum	For some reason, I'm on a roll this morning and everything has to be done in a hurry.	26 July 0902
Emotional	Emotion	And even longer to rotate the damn things reliably.	26 July 0902
Emotional	Visualization	I have a drawing that outlines the most likely conditions that could exist with the ball, bal	26 July 0924
Environment	Environment	Distracted by the TV. That seldom happens.	24 July 2031
Environment	Time	Running out of time today.	24 July 1424
Environment	Interruption	Phone....	24 July 1511
Environment	Interruption	E-mail beep!	24 July 1600
Environment	Interruption	Just returned from that rude interruption.	24 July 1600
Environment	Environment	Better go get Ethan. He must think I'm lost.	24 July 1644
Environment	Time	Aug is just around the corner.	24 July 1852
Environment	Time	Still, have a lot to do before 01Aug. May be a crash at the end.	24 July 2020
Environment	Time	Next Monday, I've got to have this thing in the mail.	24 July 2054
Environment	Time	For some reason, I'm on a roll this morning and everything has to be done in a hurry.	26 July 0902
Environment	Interruption	After two phone calls	26 July 0924
Intellectual	Focus	Loosing the bubble.	24 July 2031
Intellectual	Process	Progress numbering. Working on both sections at once.	24 July 1500

Category	Label	Passage	Date/Time
Intellectual	Concentration	Having trouble concentrating.	24 July 2020
Intellectual	Concentration	Lost the last 20 minutes.	26 July 0841
Intellectual	Linked with Pa	Gone back to 7240830 and pick-up the top section view of the fingerguard.	26 July 0846
Operation	Function	Will the door and the interlock handle function properly, or will the vector and friction ca	26 July 0730
Operation	Safety	Will the door and the interlock handle function properly, or will the vector and friction ca	26 July 0730
Operation	Safety	Door can be opened enough to insert a finger before safety interlock is engaged.	26 July 0817
Operation	Safety	Complex relationship between parts and "looks" or image of the device. Solution must fir	26 July 0841
Operation	Function	It appears that no matter what configuration cam I develop, it will be inadequate to keep fi	26 July 0843
Operation	Safety	It appears that no matter what configuration cam I develop, it will be inadequate to keep fi	26 July 0843
Operation	Function	A cam on both sides of the door is the only way to prevent injury. For that to work, the ba	26 July 0846
Operation	Safety	A cam on both sides of the door is the only way to prevent injury. For that to work, the ba	26 July 0846
Operation	Function	I must go back and find the ball pattern, then overlay with rotation to understand the limit	26 July 0846
Operation	Safety	I must go back and find the ball pattern, then overlay with rotation to understand the limit	26 July 0846
Operation	Function	I have a drawing that outlines the most likely conditions that could exist with the ball, bal	26 July 0924
Physical	Fatigue	Maybe I should quit and get some sleep.	24 July 2031
Physical	Food	Home and fed.	24 July 1852
Physical	Fatigue	Tired, and the end is in sight.	24 July 2020
Physical	Fatigue	Physically tired, and tired of this.	24 July 2054

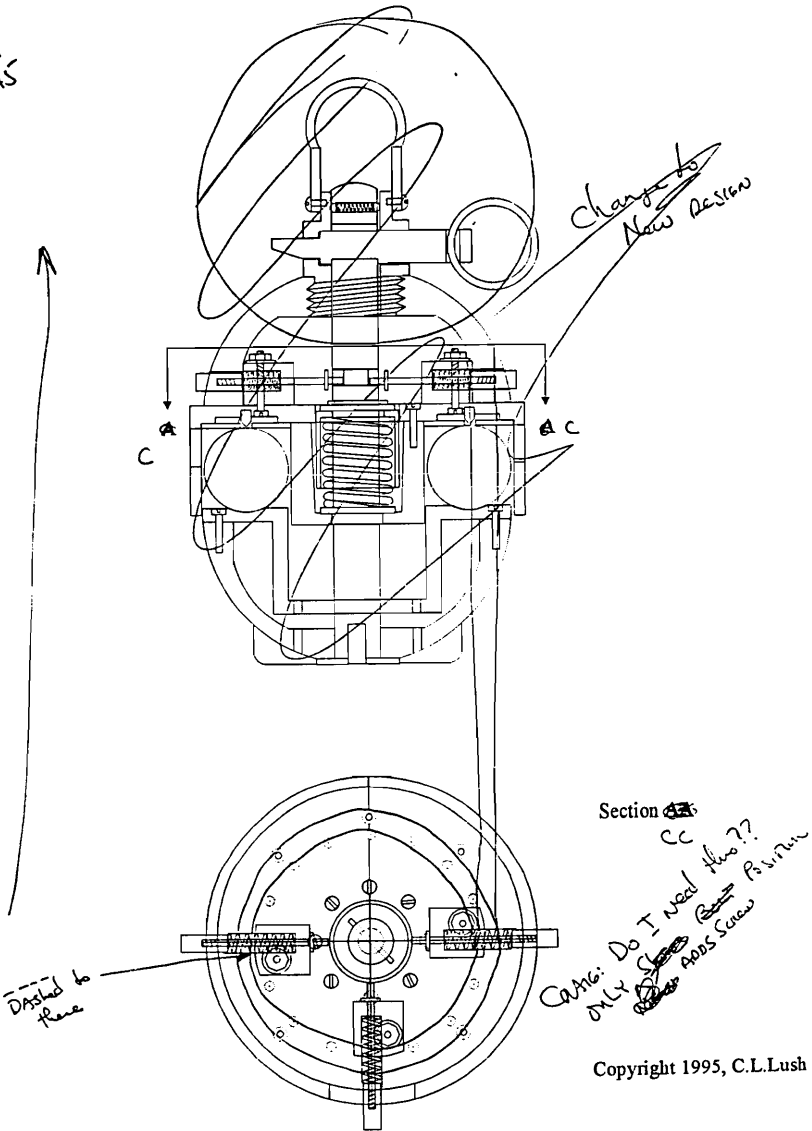
APPENDIX - N

REPRESENTATIVE SAMPLE

WRITTEN MATERIAL*

*The drawings contained within this Appendix retain their original Date Time Group (DTG) nomenclature.

622 1245



Section A-A

CC

Center: Do I need this??
ONLY 1/2" 4005 Screw

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fig 4

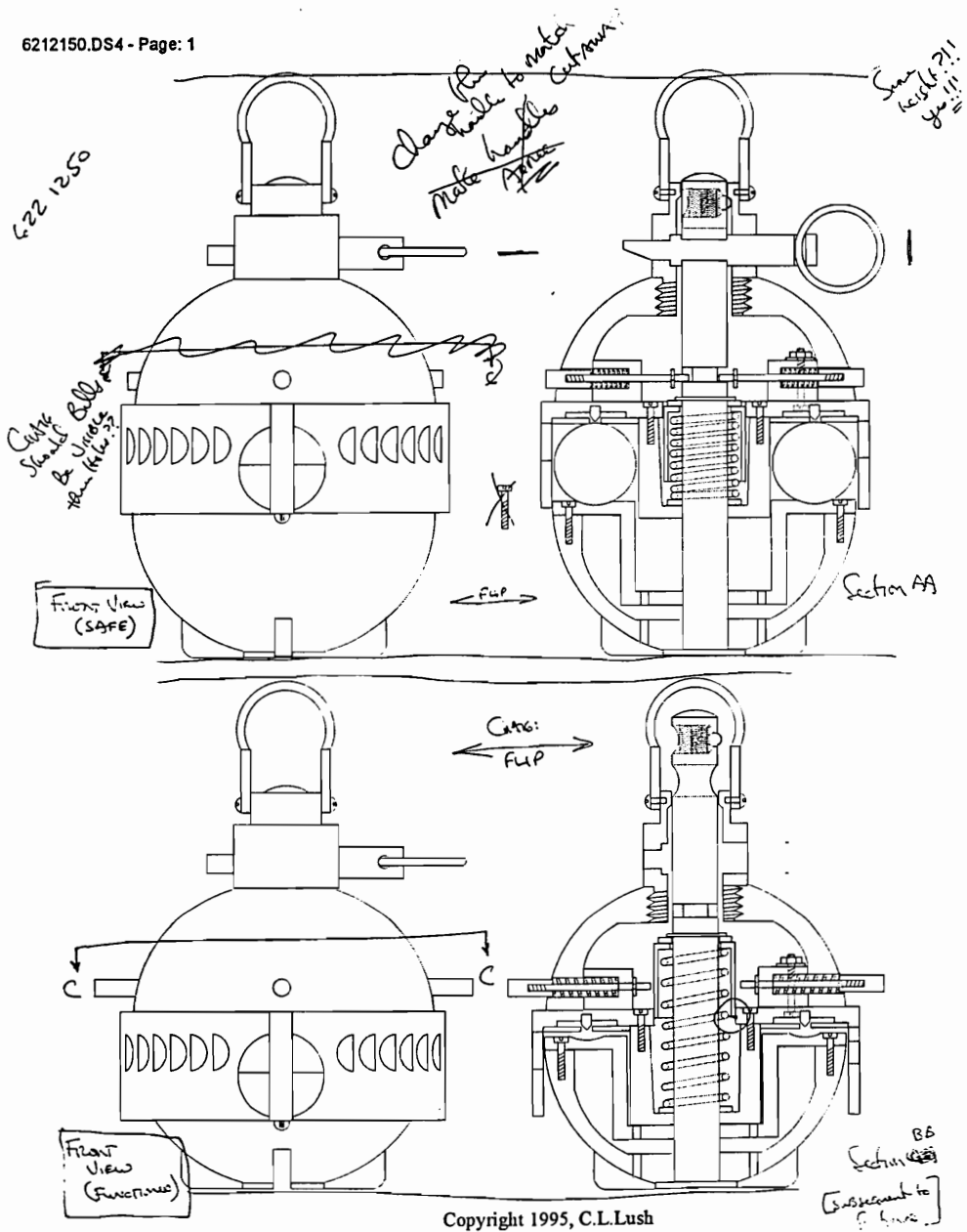
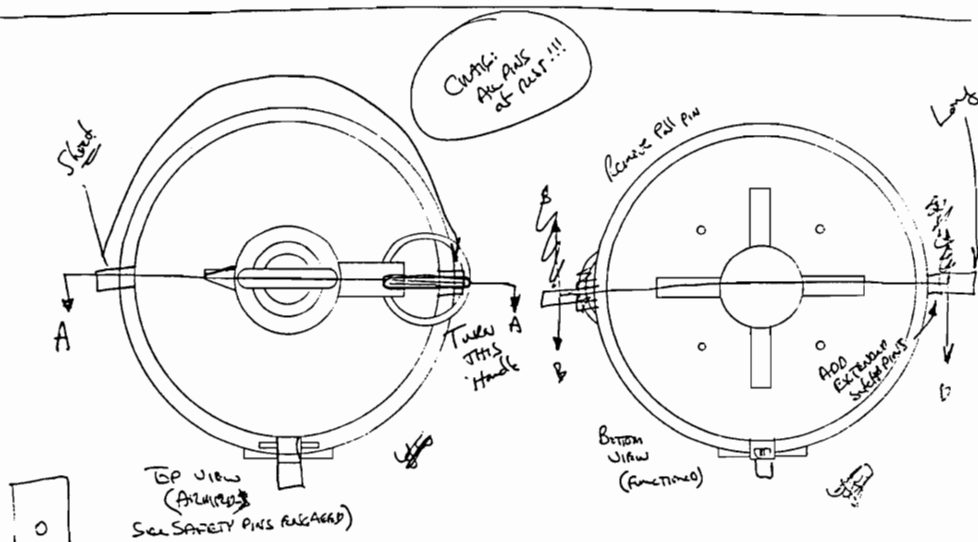
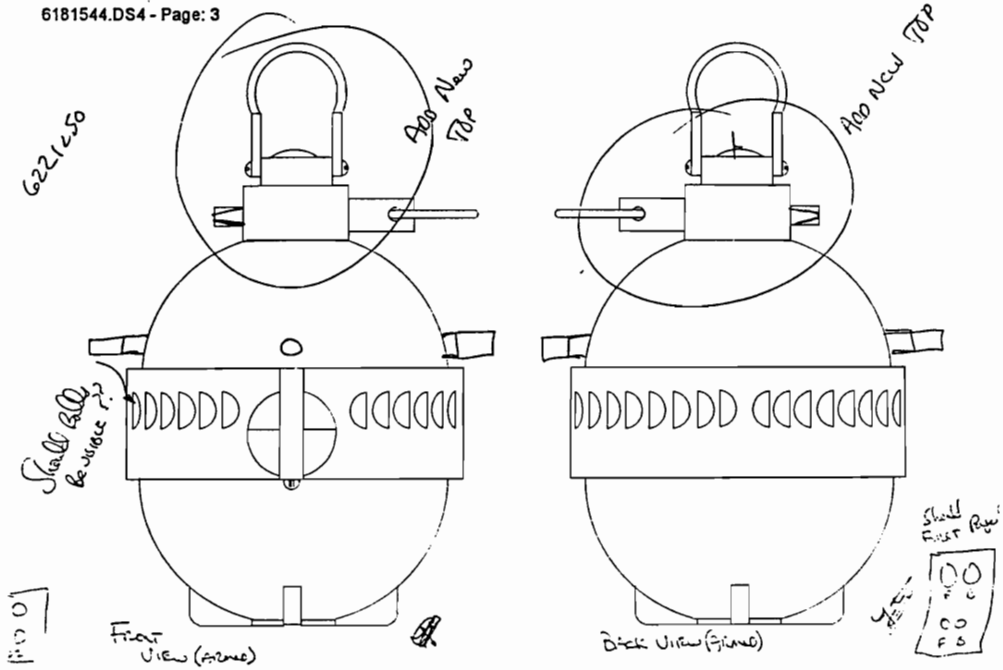
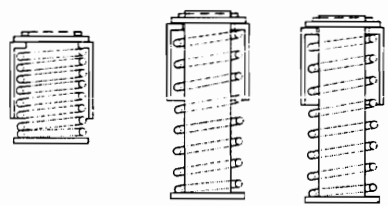
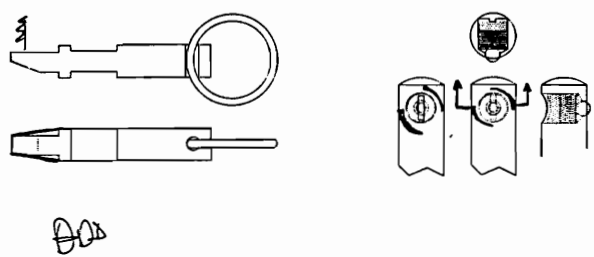


Figure 3



PAGE 2

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VITA

Craig L. Lush was born 15 September 1952 on the coast of Maine. He was educated in the public schools of Portland, Maine, and graduated from Deering High School in 1970. His Associate of Science in Business Administration and Bachelor of Science in Industrial Technology were earned at the University of Maine. A Master of Science in Management Information Systems was completed in 1992 at the George Washington University, Washington, D.C.

A career Civil Servant with the U.S. Department of Defense, Mr. Lush has held positions in a variety of Major Program Management Offices, including M1 Abrams, M2/3 Bradley Fighting Vehicles, and M9 ACE. He is currently a Professor of Program Management at the Defense Systems Management College of the DoD Acquisition University.

A stylized, handwritten signature in black ink, consisting of several loops and a long horizontal stroke extending to the right.

C.L.Lush